

COCCINELLIDAE OF WESTERN CANADA AND ALASKA WITH ANALYSES OF
THE TRANSMONTANE ZOOGEOGRAPHIC RELATIONSHIPS BETWEEN THE
FAUNA OF BRITISH COLUMBIA AND ALBERTA
(INSECTA: COLEOPTERA: COCCINELLIDAE)

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*The coccinellid fauna of western Canada and Alaska is represented by 88 recorded species, currently classified in 25 genus-group taxa, which in turn are arranged in eight tribes and five subfamilies. A synopsis of the classification of North American coccinellid genera is provided. Keys are provided for all family-group and genus-group taxa of western Canada and Alaska, and for most species. Each genus is diagnosed and described in terms of adults, and type species and junior synonyms are indicated for each generic name. Provided for each species are: synonymic list, comparative characterization, description, discussion of variation, taxonomic notes and notes on habitat, based on adults. For some species figures of diagnostic structural characteristics are also given. Three species, *Hyperaspis jasperensis*, (type locality: ALBERTA, Jasper National Park, Bald Hills), *Hyperaspidium hercules*, (type locality: ALBERTA, Medicine Hat), and *Anatis borealis*, (type locality: ALBERTA, Edmonton) are described as new. Thirty two specific names are listed as synonyms for the first time. Geographic distribution ranges are mapped for species reported from the study area. The beetles were collected in a variety of habitats including high altitude alpine, subalpine, boreal forest, arctic tundra, and semidesert arid grasslands of southeastern Alberta. Of the species recorded for western Canada and Alaska, 64 are recorded for Alberta and 75 for British Columbia, with 46 species common to both provinces. Sixteen species are confined to the west of the Continental Divide (Rocky Mountain Trench). Five species are known only from grasslands of southeastern Alberta and southwestern Saskatchewan. Nine of the 88 species (10.2%) are shared with the Palaearctic Region, and five species (5.6%) are shared with Central America. The remaining 74 species are exclusively North American. Nine species are endemic to western Canada and Alaska. The possible origin and the composition of the western Canadian-Alaskan coccinellid fauna is re-examined on the basis of available geological evidence, especially the extent of Wisconsin glaciation in North America, and location of possible refugia. Approximately 85% of the present fauna is probably derived post-glacially from North America south of the southern limit of glaciation, 12% from the Rocky Mountains refugia, and 3% from the Beringian refugium. The transmontane zoogeography of the Alberta, British Columbia portion of the fauna is discussed in detail. Altitudinal distributions are also briefly commented upon in some instances. The Rocky Mountains are not an effective barrier to dispersal of coccinellids. The Rocky Mountains played a significant role in the development of the North American coccinellid fauna, mainly as a source of new habitats.*

Nous reconnaissons dans l'ouest canadien et en Alaska 88 espèces réparties en 25 genres. Nous partageons neuf espèces (10.2%) avec la région Palaéarctique, et cinq espèces avec l'Amérique centrale. Les autres espèces sont exclusivement nord-américaines. Neuf espèces sont endémiques à notre région.

*Nous pourvoyons des clefs pour l'identification jusqu'au niveau de l'espèce. Nous avons décrit les trois espèces suivantes: *Hyperaspis jasperensis* (localité-type: ALBERTA, Parc national de Jasper, Bald Hills), *Hyperaspidium hercules* (localité-type: ALBERTA, Medicine Hat), et *Anatis borealis* (localité-type: ALBERTA, Edmonton). Nous citons pour la première fois 32 noms spécifiques comme synonymes. Pour chaque espèce nous donnons: la liste synonymique, une description comparative*

brève, une description détaillée, une discussion de la variation, des notes taxonomiques, et une description de l'habitat. De plus nous illustrons les structures diagnostiques, et présentons sur cartes géographiques la distribution nord-américaine des espèces connues de notre région. Des 88 espèces locales, 64 se rencontrent en Alberta, 75 en Colombie britannique, et 46 en commun dans les deux provinces. Seize des espèces ne se rencontrent qu'à l'ouest de la ligne du partage continental des eaux. Cinq des espèces ne se trouvent que dans les prairies du sud-est de l'Alberta et du sud-ouest de la Saskatchewan.

Nous discutons l'origine probable et la composition des coccinellides de notre région à l'aide d'évidences géologiques (étendue des glaces durant le Wisconsin en Amérique du nord, et distribution des refuges glaciaires potentiels). Environ 85% de la faune présente vient du sud de la limite glaciaire, 12% a survécu dans les refuges des Rocheuses, et 3% dans le refuge de Béringie.

Nous avons collectionné les coccinellides dans une grande diversité d'habitats dont les régions alpines, sous-alpines, boréales, arctiques, et des prairies arides. Nous discutons les problèmes zoogéographiques de l'Alberta et du la Colombie britannique en détail. De plus nous commentons sur la distribution en altitude de certaines espèces. Les Rocheuses ne présentent pas un obstacle important à la distribution des coccinellides. Cependant ces montagnes ont joué un rôle dans le développement de la faune nord-américaine des coccinellides à cause d'une abondance d'habitats nouveaux.

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INTRODUCTION

Purpose, nature and scope of this work. — The North American beetle fauna with estimated 28,600 species (Arnett, 1967) is one of the better known in the world. Comprehensive and detailed regional faunistic studies are logical continuations to further refine and increase this knowledge. Presented here is a faunal-taxonomic study of one family of Coleoptera, the Coccinellidae, in western Canada and Alaska, based mainly on external morphological features of adults, with emphasis on color pattern.

The primary objective of this study was first, to determine the composition of the western Canadian-Alaskan coccinellid fauna, and to integrate this information into the framework of current classification of Coccinellidae. Secondly, analyses of the transmontane relationships between the coccinellid fauna of British Columbia and Alberta elucidate some problems connected with geographic isolation of species, refugia, vicariance and speciation.

Coccinellidae in general. — Coccinellid beetles are one of the better known groups of Coleoptera: primarily because of their popularity among naturalists for distinctive appearance, and their diurnal, non-secretive mode of life; secondarily, coccinellids received considerable attention as potential biological control organisms of some agricultural and forest pests. Faunistically, the group is best known from Europe, Japan, and eastern North America. The coccinellid faunas of Africa, Australia, Asia, and South America have been investigated only superficially. There has been little effort made to integrate the widely scattered, and diverse information about coccinellids into the framework of a classification for the taxa described. Authors prior to 1900 did not understand how extensively color could vary within single species, so it is generally impossible to identify a described species without access to type material. Most color variants in polymorphic species were described as distinct species, eventually resulting in long synonymies and chaos in nomenclature. I estimate that, at present, the world fauna is represented by more than 4,200 described species. This is approximately 75% of the total number of extant species.

North American Coccinellidae. — More than 400 described species of Coccinellidae comprise

the North American fauna, with highest diversity in the southwestern part of the continent. Undoubtedly, additional species will be described, mainly in the genera *Scymnus* (*sensu latiore*), and *Hyperaspis* Dejean. The family is in need of a revision on a continental basis, but more detailed knowledge is required for the southern elements of the Nearctic fauna and those of Middle America.

Major contributions to knowledge of North American Coccinellidae are papers by: Brown (1950, 1962, 1967); Brown and de Ruelle (1962); Casey (1899, 1908, 1924); Chapin (1946, 1965a, 1965b); Crotch (1873, 1874a, 1874b); Dobzhansky (1931, 1935, 1941); Gordon (1970a, 1970b, 1970c, 1970d, 1970e, 1972, 1974a, 1974b, 1976); Horn (1895); LeConte (1850, 1852, 1854, 1878); Leng (1903a, 1903b, 1908, 1911, 1920); Leng and Mutchler (1933); McKenzie (1936); Nunenmacher (1909, 1911, 1912a, 1912b, 1913, 1934a, 1934b, 1937, 1944, 1946, 1948); Say (1824, 1826, 1835); Stehr (1930); Timberlake (1943); Watson (1954, 1956); and Wingo (1952).

Coccinellid fauna of western Canada and Alaska. — A historical account of general insect collecting in northern Canada was given by Freeman (1958). Treatment of coccinellids of this fauna is limited to lists of taxa only. These are: Fall (1926), and Scott (1933) for Alaska; Leng (1919) for Northwest Territories; Brodie (1888); Carr (1920) for northern Alberta; Anonymous (1906), Clark (1948), Dobzhansky (1935), and Keen (1895) for parts of British Columbia. Hatch (1962) in his synopsis of species of beetles in the Pacific Northwest covered British Columbia.

THE STUDY AREA: MOUNTAIN SYSTEMS

The study area consisted of the American state of Alaska, the Canadian Yukon Territory, Northwest Territories, provinces of Alberta and British Columbia. Almost a quarter of the North American continent in size, the study area is physiographically varied and complex. Three major physiographic regions occupy most of the area: (1) Cordilleran region; (2) part of Interior Plains; and (3) part of the Canadian Shield. Munroe (1956) discussed in a general way Canada as an environment for insect life.

The North American Cordillera consists of two parallel mountain systems: the Rocky Mountain System on the east, and the Pacific Mountain System on the west. Between these is a series of Intermontane Plateaus. The collective term Northern Rockies includes the Canadian Rockies and parallel ranges of the Montana Rockies actually continuous with each other. The easternmost section of the Northern Rockies is separated from other ranges in both the United States and Canada by a pronounced depression known as the Rocky Mountain Trench, extending from Flathead Lake in Montana northward to the headwaters of the Yukon River. West of the Rocky Mountain Trench in British Columbia and the United States, is a succession of three interdigitating mountain ranges. These are the Purcell, Selkirk and Columbia Ranges. Each range is truncated obliquely across its northern end by the Rocky Mountain Trench, suggesting that all three were formed prior to the eastern Rocky Mountains. The southern continuation of the three ranges is represented by the Bitterroot and associated smaller ranges in Montana. The Interior Plains extend into the study area only in the southeastern Alberta, and the Canadian Shield in northernmost Alberta and Northwest Territories.

Most parts of the Northern Rockies have been profoundly glaciated during Wisconsin time by local glaciers of alpine type (Flint, 1963; Wright and Frey, 1965). The Eastern Cordillera and Interior Plains located in Alberta and British Columbia have been extensively glaciated. Evidence indicates that continental ice-sheet, originating in the northeast, has extended into the west central area of Alberta at least twice, whereas in the southern part of the Province the available evidence suggests at least five advances. During its maximum extent, continental

ice reached the eastern flanks of the Canadian Rocky Mountains in the extreme southern part of the area, and in northeastern British Columbia, whereas in the intervening area the ice fell short of the mountain front by tens of miles. The Rocky Mountains supported ice throughout the Pleistocene with evidence of at least four advances, some of which extended well to the east from the mountain front, and in places and at varying times joined the continental ice-sheet. Although a well defined, absolute chronology is not available for the area, it is assumed that glacial deposits located on or near the surface are Wisconsinian in age. It may be that during the maximum extent of the "Classical Wisconsin" large tracts of the plains area of southern Alberta were not glaciated. Areas that appear not to have been glaciated include Cypress Hills, the higher peaks of the Rocky Mountains, and parts of the Foothills.

Farther north, in the Yukon and Northwest Territories, the effects of glaciation are less well known. However, available evidence suggests two Continental ice advances that extended well into the mountain front to the west. Within the mountains, available evidence supports multiple glaciation. Wide areas between the western limits of eastern ice, and that which originated in the mountains, were not affected, or at the most, only by a relatively early ice advance. Most of the western Yukon was not glaciated during the Pleistocene (N.W. Rutter, Department of Geology, University of Alberta; Personal communication, 1975).

MATERIALS AND METHODS

Materials

During the course of this investigation 12,480 adults and more than 300 immatures of the North American Coccinellidae were studied, most (78%) of which were collected within the study area as defined earlier. Portions of summers (1972-73) were spent collecting in the Yukon, Northwest Territories, British Columbia and Alberta. The states of Washington, Idaho and Montana were also visited briefly to supplement the collections from the Canadian Rocky Mountains. Alaska was not visited.

About 90% of the specimens studied were loaned by museums and private collectors. The following abbreviations, as used in the text or in the records deposited in the University Archives, identify these collections and curators in charge of them.

BNPC	Banff National Park Collection, Banff Museum, Banff, Alberta. J. Holroyd.
CAS	California Academy of Sciences, San Francisco, California 94118. H.B. Leech, D.H. Kavanaugh.
CDAL	Canada Department of Agriculture, Research Station Lethbridge, Alberta T1J 4B1. A.M. Harper.
CDAS	Canada Department of Agriculture, Research Station Summerland, British Columbia V0H 1Z0. R.D. McMullen.
CNC	Canadian National Collection of Insects, Biosystematics Research Institute, Ottawa, Ontario K1A 0C6. E.C. Becker, R. de Ruelle.
CUNY	Cornell University, Ithaca, New York 14850. H. Dietrich, L.L. Pechuman.
FMNH	Field Museum of Natural History, Chicago, Illinois 60605. H. Dybas.
HAHc	Henry and Anne Howden collection, Carleton University, Ottawa, Ontario. H.F. Howden.
IUB	Department of Zoology, Indiana University, Bloomington, Indiana 47401. F.N. Young.
JBel	University of Alberta, Strickland Museum collection, Department of Entomology, Edmonton, Alberta T6G 2E3. G.E. Ball
JCarr	John L. and B.F. Carr collection, Calgary, Alberta T3A 1Y2. J.L. Carr.

MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts 02138. J.F. Lawrence, J.C. Scott.
MSU	Department of Zoology and Entomology collection, Montana State University, Bozeman, Montana 59715. N.L. Anderson.
NFRC	Northern Forest Research Centre, Edmonton, Alberta T6H 3S5. H.R. Wong, J.C.E. Melvin.
PMRS	Provincial Museum of Natural History, Wascana Park, Regina, Saskatchewan S4S 0B3. R.R. Hooper.
UASM	University of Alberta, Strickland Museum collection, Department of Entomology, Edmonton, Alberta T6G 2E3. G.E. Ball.
UBC	University of British Columbia, Department of Zoology, Vancouver, British Columbia V6T 1W5. G.G.E. Scudder.
UCB	University of Colorado, Department of Entomology, Boulder, Colorado 80302. U.N. Lanham.
UCKC	University of Calgary Environmental Centre Kananaskis, Kananaskis, Alberta T2N 1N4. G. Pritchard.
UIM	University of Idaho, Department of Entomology, Moscow, Idaho 83843. W.F. Barr.
USNM	United States National Museum, Natural History, Washington, D.C. 20560. R.D. Gordon.
WSUP	Washington State University, Department of Entomology, Pullman, Washington 99163. W.J. Turner.
WWat	W.Y. Watson collection, Department of Biology, Wilfrid Laurier University, Waterloo, Ontario N2L 3C5. W.Y. Watson.
ZIUL	Zoological Institute, University of Lund, S-223 62 Lund, Sweden. C.H. Lindroth.

Methods

General. — Terms used in the text are explained where necessary. References to drawings, photo-micrographs and maps were made in appropriate places. All measurements are in millimeters unless stated otherwise. Descriptions of color and measurements are based on preserved specimens, and measurements are given as an interval without indication of sample size: Total Length (TL) 6.0-9.0 mm; Width (W) 2.1-2.5 mm.

Descriptions. — To minimize redundancy, only characteristics peculiar to a given lower ranking taxon are presented in its description. Characters common to all members of a given higher ranking taxon are in the description of that group.

Dissections. — Sclerotized parts of both male and female genital armature were routinely dissected and studied with the aid of a binocular microscope (Wild M5). Standard dissecting techniques were used. The extracted genital armature or parts of, were stored in small plastic vials partially filled with glycerine, and pinned through the cork, beneath the specimen.

Taxonomic methods. — Specimens were first sorted into groups based on external morphological similarity, especially size, maculation, and microsculpture. The groups thus established were further sorted by geographic locality, e.g., east or west of the Rocky Mountains. A survey of the male genital armature within each group refined the sorting further yet. To analyze color variation, I examined the male genital armature in at least 10 most extreme variants in groups where needed. After this preliminary sorting, most specimens could be assigned to species. Comparisons with type specimens were made where possible. Depository of type specimens is indicated where known. Most of the types of species described by J.L. LeConte and G.H. Horn are in the Museum of Comparative Zoology at Cambridge, Massachusetts. Other important collections containing type specimens are as follows: M.E. Mulsant and V.T. Motschulsky, University of Moscow, Soviet Union; J.F.W. Herbst and J. Weise, Museum für

Naturkunde, Berlin; G.R. Crotch, Cambridge University, England; C. Linnaeus, British Museum of Natural History, England; and J.C. Fabricius, Zoological Museum at Copenhagen, Denmark.

Subspecies were not recognized. Wilson and Brown (1953) pointed out the arbitrariness and difficulties in recognition and naming of subspecific taxa. In Coccinellidae many of the species exhibit pronounced geographic variation, particularly of color and pronotal and elytral maculation of adults. Recognition of subspecies based on single character systems, i.e., elytral maculation, or male genital armature is not satisfactory. Independent character systems generally show independent geographic variation (Shull, 1945, 1946a). Thus I agree with the above authors that naming of subspecies generally obscures much variation.

Illustrations

Fig. 1-78 were adapted and redrawn from Hatch (1962), or McKenzie (1936), and I here acknowledge their use. Descriptions are supplemented by line drawings of other structures where appropriate. The drawings were made with the aid of a camera lucida mounted on a Wild M5 stereoscopic microscope. Antennae, tarsal claws, microsculpture, were photographed with the aid of a scanning electron microscope (Cambridge, Stereoscan S4). Some photomicrographs are reproduced as such, (Fig. 173-188) to show details which otherwise would be lost in line drawings. In some instances, figures were traced from photomicrographs (Fig. 190-191).

Distribution maps based on records that I was able to confirm by examination of specimens are provided for species reported from the study area. Detailed distribution records for this material are in the Archives of the University of Alberta, and will be made available on request addressed to the Department of Entomology.

Taxonomic literature

Only those published works directly pertinent to classification of North American Coccinellidae were cited. Generally excluded were references to works which did not propose any changes, either in concepts or nomenclature, e.g., faunal lists and catalogues. Since the International Commission for Zoological Nomenclature does not regulate the use of names for varieties or aberrations, such names, as published in the literature were generally disregarded and are omitted from synonymies here.

CLASSIFICATION

Family Coccinellidae

Coccinelle Olivier, 1808:991; Coccinellides Leach, 1815:1, Aphidiphagi Latreille, 1818:531; Aphidiphaga Kirby, 1837:228; Coccinoloidea Hope, 1840:28, 156; Aphidicola Motschulsky, 1845:332; Coccinelliens Blanchard, 1845:201; Securipalpes Mulsant 1846:1; Coccinelloidea Costa, 1849:1; Coccinellae LeConte, 1852:130; Pseudotrimeria Emmons, 1854:136; Coccinelles Bouillon, 1858:1; Siphonophora Verhoeff, 1895:73; Pseudococcinellidae Weise, 1887:185. Cerasommatidiidae Brethes, 1925:199.

See Korschefsky (1931, 1932) for a listing of the earlier literature on the family.

Diagnostic characterization

Adults. — Prominently convex to subhemispherical in shape. North American members, TL 0.8-1.2 mm. Few atypical representatives elongate-oval and oblong. Elytra entire, not striate or truncate, either glabrous or pubescent. Elytra and pronotum maculate or not, maculation of distinct spots or bands. Tarsal formula 4-4-4, article 3 greatly reduced; or 3-3-3. Tarsal claws appendiculate, cleft or simple (Fig. 181-188). Antennae of 7 to 11 articles each, retracted beneath head at rest (Fig. 192).

Larvae. — Elongate, campodeiform. TL 2-18 mm. Head prognathous. Antennae of 1, 2, or generally 3 articles each. Mandibles sickle-shaped, enlarged at base, with retinaculum (except

in *Microweisea*). Hypopharyngeal bridge well developed. Maxillary palpus of 3 articles, except in *Noviini* with 2 articles each. Labial palpus of 1 or 2 articles each. Ocelli three. Abdomen ten segmented, covered with setae and sclerotized plates with tubercles.

Major contributions to morphology and systematics of coccinellid larvae are papers by: Böving (1917); Emden (1949); Gage (1920); Kamiya (1964); Klausnitzer (1970); Savojskaja (1960, 1962, 1963, 1964a, 1964b); Savojskaja and Klausnitzer (1973); Strouhal (1927).

Pupae. — Obtect, without cocoons; in species of some genera, e.g., *Chilocorus*, *Epilachna*, pupae are partially enveloped by last larval skin. Attached to substrate by caudal end. Pupae of North American coccinellid species were discussed from the standpoint of structure, taxonomy and phylogenetic relationships by Phuoc and Stehr (1974).

Description of adults

Beetles of minute to medium size (0.8 - 18.0 mm). Body prominently convex to subhemispherical; members of some taxa elongate-oval, oblong. Color: varied, all colors of visible spectrum represented; members of several taxa concolorous or metallic; majority maculate or pronotum and elytra by distinct spots or bands. Vestiture: dorsal surface glabrous or pubescent, ventral surface and legs setose. Microsculpture: varied, from surface smooth (Fig. 81), to distinctly punctate (Fig. 84), or shagreened (isodiametric meshes well impressed, as in Fig. 79, 80, 82).

Head. Capsule transverse quadrate, corners round. Compound eyes large, situated latero-anteriorly. Ocelli absent. Post-antennal process projected into eyes anteriorly, widely so in *Epilachnini*, *Psylloborini* and some *Coccinellini*; narrowly in *Stethorini*, *Scymnini*, *Noviini*, *Scymnillini*, *Coccidulini*, some *Coccinellini*, and *Sticholotini*. Surface of eyes finely faceted except in *Coccidulini* and *Lithophilini*.

Antennae. (Fig. 175, 177, 178, 192). Inserted in front of eyes, generally of 11 articles each, moderately long and clavate. Freely movable and retractile. Number of articles and/or length reduced in many groups.

Labrum. Transverse quadrate sclerite with rounded sides. Narrower than clypeus, except in *Rodolia*. Exposed or not.

Mandibles. Prominent in most members, acute at apex, bifid or not, most groups with basal tooth. In *Sticholotini*, without basal tooth and with simple apex. *Epilachnini* without basal tooth, with several denticles and large teeth on cutting edge.

Maxillae. Each of 4 articles. Apical article varied in shape in different groups, from triangular (securiform) to trapezoidal or slender and slender. Galea elongate, setigerous.

Labium. Of three parts; submentum, mentum and prementum. Labial palpus of 3 or 2 articles each (Fig. 191).

Thorax. Pronotum relatively large, convex. In some groups explanate anteriorly and/or laterally. Externally visible part of prosternum T-shaped, with broad intercoxal process and lateral wings in front of coxae. Prosternum of members of some species with distinct longitudinal carinae (posternal carinae) on the surface of intercoxal process. Mesosternum short, with median posterior intercoxal process. Middle coxal cavities open. Surface of metasternum with arcuate femoral line, extended postero-laterally from middle coxal cavity.

Elytra. Convex to prominently convex, not truncate or striate. External margin reflexed, or explanate in some groups (*Chilocorini*) exceptionally. Epipleura with or without foveae for reception of hind femora.

Hind wings. (Fig. 189). Large and functional in most groups. Reduced and non-functional in members of some Euro-Asian genera, e.g., *Strictobura*, *Lithophilus*.

Legs. (Fig. 173, 174). Coxae normal type, non-variant. Trochanters, of normal type for Cucujoidea. Femora grooved. Tibiae, normal to variously modified, spinose and grooved (Fig. 176). Distal ends of middle and hind tibiae with or without spurs. Tarsal formula 4-4-4, or 3-3-3 in *Stethorini*, part of *Scymnini*, *Noviini*, *Ortalini*, *Aspidimerini*. Tarsal claws, each simple or variously modified, notched (Fig. 181-188).

Abdomen. With five or six visible sterna, first visible sternum being the 3rd morphological one (III). Surface of sternum III sculptured with oblique lines (metacoxal arcs) projected postero-laterally (Fig. 179, 180).

Male genital armature. (Plate A, p. 290). Structural components are homologous with those of other Coleoptera but modified to such an extent that their homologies are no longer obvious. These homologies were elucidated by Sharp and Muir (1912), Jeannel (1955), and the terms used are clarified in the following. Aedeagus: (Ae), composite structure of median lobe and tegmen together. Basal piece: (Bp), proximal part of tegmen. Basal lobe: (Bl), part of tegmen median to lateral lobes. Connective membrane: (Cm), tissue connecting tegmen and body wall. Internal sac: (Is), eversible membranous sac at apex of median lobe. Lateral lobes: (Ll), paired processes of tegmen. Ejaculatory duct: (Ed), sperm duct. Median lobe: (Ml), tubular structure bearing intromittent sac at apex, through which sperm is discharged. Tegmen: (Te), composite structure; basal lobe + lateral lobes. Tegminal strut: (Ts), sclerite articulated with abdomen. Siphon: (Si), part of median lobe.

Natural History

This was reviewed in detail by Hagen (1962), Hodek (1967), and Hodek *et al.* (1973).

PLATE A

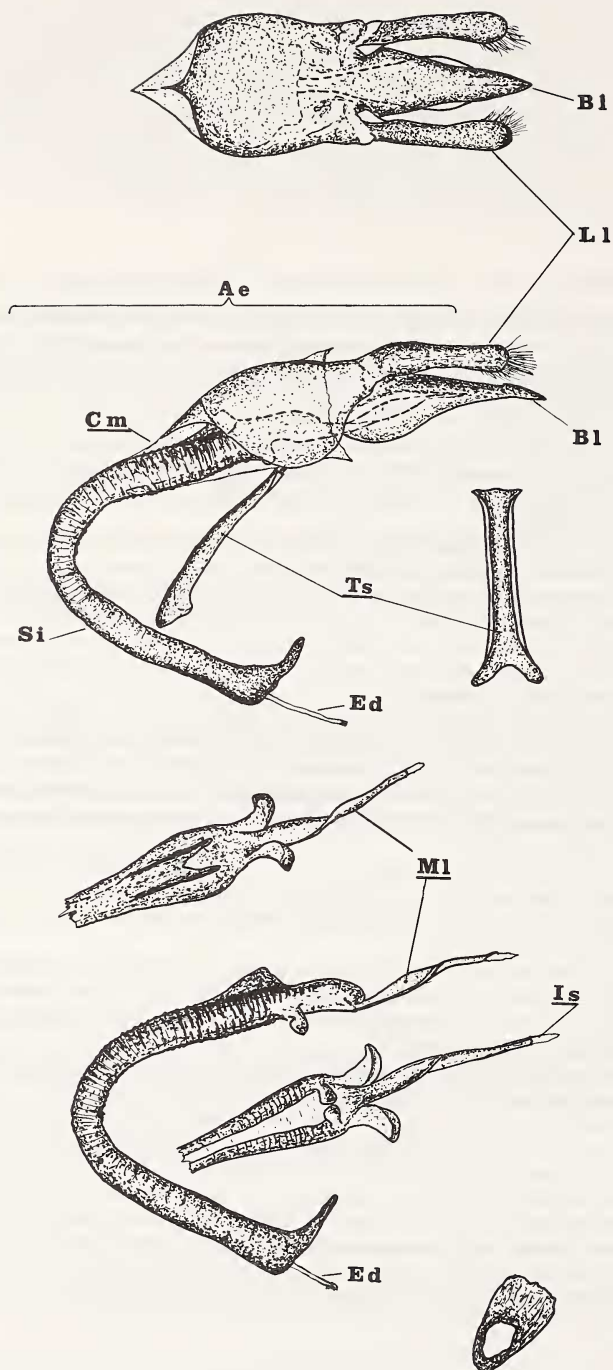


Plate A. Diagram of male genital armature of *Hippodamia variegata* Goeze. Ae.-Aedeagus. Bl.-Basal lobe. Bp.-Basal piece. Cm.-Connective membrane. Ed.-Ejaculatory duct. Is.-Internal sac. Ll.-Lateral lobes. Ml.-Median lobe. Te.-Tegmen. Ts.-Tegminal strut. Si.-Sipho.

Balduf (1935), Clausen (1940) and Hodek (1966) covered aspects of this subject at some length.

Habitat. — The usual criterion for definition of a typical habitat is one in which a given species completes its life cycle (Hodek, 1973). In general, adults are little restricted to a particular site because of their great mobility and search for prey. Thus, a species whose adults are found almost everywhere, e.g., *Hippodamia tredecimpunctata*, is restricted to open fields for breeding. However, some species of some genera have become associated with ants, e.g., *Brachiacantha*, *Scymnus*, *Hyperaspis* (Wheeler, 1911). Most species recorded for western Canada and Alaska are predaceous (see below for food habits), and therefore primary association is to their hosts. Habitats where I collected coccinellids range from arctic, subarctic tundra, alpine tundra, boreal forests of western North America, chaparral, sagebrush communities, to semidesert grasslands of southeastern Alberta.

Altitudinal distribution of Nearctic Coccinellidae. — In general, coccinellid beetles range from sea-level to the highest peaks of North American mountains (15,000 ft; 5,000 m). Most species are restricted to a particular habitat, which in most instances is defined by upper and lower elevation limits. Typical alpine taxa are, e.g., *Hippodamia oregonensis*, *Coccinella alta*, *Hyperaspis jasperensis*, species which are restricted to and complete their life cycle in alpine zone of the Rocky Mountains. Since the vertical zonation of habitats is latitude-dependent, i.e., alpine zone is at considerably higher elevations at southern latitudes, correspondingly the altitudinal distribution of coccinellids varies with latitude. Many species of Coccinellini form aggregations, notable near mountain peaks (reviewed by Hagen, 1966).

Mating. — The first copulation takes place a few days after emergence and is usually repeated several times during adult life. One copulation is in most cases sufficient to give the female lifetime fertility, but for those of some species, e.g., *Stethorus*, which lack a spermatheca, repeated mating is a necessity (Putman, 1955a).

Adult longevity. — Individuals of species studied in this respect had a maximum life span corresponding to one season, or about one year. Exceptional records indicate possibility of a second hibernation, e.g., *Stethorus* (Putman, 1955a), *Propylaea* (El-Harri, 1966).

Parasites and predators. — Larvae, pupae, and adult coccinellids are commonly parasitized by ichneumonid and chalcid wasps. Richerson (1970) provided a world list of parasites of Coccinellidae. Adults are eaten by birds and bears (hibernating aggregations).

Food habits. — This topic was reviewed by: Balduf (1935); Clausen (1940); Kamiya (1966); Hodek (1973); Sasaji (1967, 1971). Schilder and Schilder (1928) listed the prey species systematically. Predaceous coccinellids feed both as larvae and adults on a variety of homopterous insects: aphids, scale insects, psyllids; immature Coleoptera (Chrysomelidae); Acarina (Tetranychidae), and occasionally eat pollen and plant tissue. One group, Epilachninae, are exclusively phytophagous on Cucurbitaceae, Solanaceae, and Leguminosae. Members of the tribe Psylloborini are specialized as fungivores, and feed on mildews of *Erysiphe*, *Sphaerotheca*, *Podosphaera* species (Davidson, 1921). Larvae in general feed on the same host species as adults, and in most instances the food preference is species-specific.

Revised generic classification of North American Coccinellidae

I followed Sasaji's (1968) arrangement proposed for suprageneric taxa, and modified accordingly the arrangement of genera within tribes from that used by Arnett (1968). This classification provides a general reference for arrangement of genus-group taxa in the systematic part. Taxa recorded from western Canada and Alaska are indicated by an asterisk (*).

SUBFAMILY STICHOLOTINAE (*)

Tribe Serangiini

- Dephastus* Casey, 1899:111.
Lioscymnus Champion, 1913:125.

Tribe Sticholotini (*)

- Microscymnus* Champion, 1913:127.
Microweisea Cockerell, 1903:38.(*)
Smilia Weise, 1891:288. Not Germar, 1838.
Epismilia Cockerell, 1900:606. Not Fromental, 1861.
Pseudoweisea Schwarz, 1904:188. Misquotation.
Nipus Casey, 1899:132,133.
Gnathoweisea Gordon, 1970:47.

SUBFAMILY SCYMNINAE (*)

Tribe Stethorini (*)

- Stethorus* Weise, 1885:65. (*)

Tribe Scymnini (*)

- Scymnus* Kugelann, 1794:545.
*Scymnus (sensu stricto)**
Pullus Mulsant, 1846:251.(*)
Nephus Mulsant, 1846:237.(*)
Nephus (sensu stricto)
Sidis Mulsant, 1850:975.
Turboscymnus Gordon, 1976:287.
Scymnobioides Casey, 1899:139.
Depressoscymnus Gordon, 1976:315.
Diomus Mulsant, 1850:951.
Cephaloscymnus Crotch, 1873:382.
Selvadius Casey, 1899:134, 137.
Didion Casey, 1899:134, 137. (*)
Blaisdelliana Gordon, 1970:43.

Tribe Hyperaspini (*)

- Hyperaspis* Dejean, 1836:459. (*)
Cleothera Mulsant, 1850:541.
Oxynychus LeConte, 1850:238.
Hyperaspidioides Crotch, 1873:382. (*)
Brachiacantha Dejean, 1836:458. (*)
Brachyacantha Chevrolat, 1842:705. Unjustified emendation.
Thalassa Mulsant, 1850:506, 511.
Helesius Casey, 1899:116, 129.

Tribe Cryptognathini

- Calloeneis* Grote, 1873:143. Replacement name for *Oeneis* Mulsant.
Oeneis Mulsant, 1850:497, 500. Not Hübner, 1819.
Delphastopsis Casey, 1924:170.
Dargo Chapin, 1955:87. Unnecessary replacement name for *Oeneis* Mulsant.

Tribe Scymnillini

- Zagloba* Casey, 1899:113.
Scymnillus Horn, 1895:110.
Zilus Mulsant, 1850:958.
Scymnilloides Sicard, 1922:355.

SUBFAMILY CHILOCORINAE (*)

Tribe Chilcorini (*)

- Axion* Mulsant, 1850:477.
Chilocorus Leach, 1815:116. (*)
Chilochorus Hope, 1840:157. Misspelling.
Exochomus Redtenbacher, 1843:11. (*)
Arawana Leng, 1908:34, 38.
Brumoides Chapin, 1965a:237. (*)
Brumus: of authors. Not Mulsant, 1850.
Halmus Mulsant, 1850:471.
Orcus Mulsant, 1850:467.

SUBFAMILY COCCIDULINAE (*)

Tribe Coccidulini (*)

- Coccidula* Kugelann, 1798:421. (*)
Cacidula Curtis, 1826:184. Misspelling
Cacicula Stephens, 1828:319. Misspelling
Strongylus Panzer, 1813:114. Junior synonym.
Lindorus Casey, 1899:161, 162.
Rhizobius Stephens, 1831:396.
Rhizobius Stephens, 1831:373. Misspelling.

Tribe Exoplectrini

- Exoplectra* Dejean, 1836:461.
Vedalia Mulsant, 1850:901, 905.

Tribe Noviini

- Anovia* Casey, 1908:408.
Rodolia Mulsant, 1850:280, 902.
Novius Mulsant, 1850:942. Replacement name for *Nomius* Mulsant, 1846.
Nomius Mulsant, 1846:213. Not Laporte, 1835.

SUBFAMILY COCCINELLINAE (*)

Tribe Coccinellini (*)

- Anatis* Mulsant, 1846:133. (*)
Myzia Mulsant, 1846:277. (index). (*)
Mysia Mulsant, 1846:129. Not Lamarck, 1818.
Neomysia Casey, 1899:98. Junior synonym.
Paramysia Reitter, 1911:136, 144. Junior synonym.
Calvia Mulsant, 1846:140. (*)
Anisocalvia Crotch, 1871:4. (*)
Propylaea Mulsant, 1846:147, 152.
Adalia Mulsant, 1850:49. Replacement name for *Idalia* Mulsant. (*)
Idalia Mulsant, 1846:133. Not Hübner, 1819.
Olla Casey, 1899:84, 93. (*)
Cycloneda Crotch, 1871:6. (*) Replacement name for *Daulis* Mulsant, 1850.
Daulis Mulsant, 1850:295. Not Erichson, 1842.
Coccinella Linnaeus, 1758:364. (*)
Spilota Billberg, 1820:61. Junior synonym.
Hippodamia Dejean, 1836:456. (*)
Hemisphaerica Hope, 1840:157. Junior synonym.
Adonia Mulsant, 1846:39. Junior synonym.
Ceratomegilla Crotch, 1873:365. (*)
Spiladelphina Semenov and Dobzhansky, 1923:99.
Coleomegilla Timberlake, 1920:139. Replacement name for *Megilla* Mulsant, 1850:24. Preoccupied.
Megilla Mulsant, 1850:24. Not Fabricius, 1804.

- Ceratomagilla*: Malkin, 1943:194. Misspelling.
Eriopsis Mulsant, 1850:6.
Eriopsis: Timberlake, 1943:10. Misspelling.
Macronaemia Casey, 1899:76. (*)
Micronaemia Weise, 1905:218. Unjustified emendation.
Mulsantina Weise, 1906:34. (*) Replacement name.
Cleis Mulsant, 1850:132, 135. Not Guérin-Ménéville, 1831. Not Mulsant, 1850:162.
Pseudocleis Casey, 1908:406. Junior synonym.
Aphidecta Weise, 1899:375.
Bulaea Mulsant, 1850:36.
Naemia Mulsant, 1850:30. (*)
Neoharmonia Crotch, 1871:2.
Agrabia Casey, 1899:87. Junior synonym.
Neoharmonia Casey, 1899:90. Junior homonym.
Harmoniaspis Casey, 1908:404. Junior synonym.

Tribe Psylloborini (*)

- Psyllobora* Dejean, 1836:458. (*)
Phyllobora Chevrolat, 1844:43. Misspelling.

SUBFAMILY EPILACHNINAE

Tribe Epilachnini

- Epilachna* Dejean, 1836:460.

Tribe Madaini

- Subcoccinella* Huber, 1842:376.

Key to adults of the coccinellid tribes of Canada and Alaska

- | | | | |
|----|--------|--|-----|
| 1 | (0) | Dorsal surface glabrous or only with sparse hairs | 2 |
| 1' | | Dorsal surface distinctly pubescent | 6 |
| 2 | (1) | Clypeus prominently expanded laterally to emarginate eyes | |
| | | Chilocorini, p. | 295 |
| 2' | | Clypeus not prominently expanded laterally | 3 |
| 3 | (2') | Body length 0.8-1.5 mm. Terminal article of maxillary palpus conical. | |
| | | Sticholotini, p. | 295 |
| 3' | | Body length greater than 1.5 mm. | 4 |
| 4 | (3') | Body length max. 5.0 mm. Antenna (Fig. 178) much shorter than interocular distance | |
| | | Hyperaspini, p. | 295 |
| 4' | | Body length 3.0-12.5 mm. Antenna (Fig. 192), longer than interocular distance, and distinctly clavate | 5 |
| 5 | (4') | Clypeus with prominent, forward projections in front of eyes. Anterior margin of pronotum recessed above eyes (anterior pronotal angles prominent). Mandibles bifid at apex. Body length 3.0-12.5 mm | |
| | | Coccinellini, p. | 295 |
| 5' | | Anterior margin of clypeus straight, without forward lateral projections. Pronotum with anterior margin not distinctly recessed, sinuate only. Mandibles with multidentate apices. Body length max. 3.0 mm | |
| | | Psylloborini, p. | 296 |
| 6 | (1') | Body length min. 5.0 mm, prominently convex. Mandibles multidentate at apex | |
| | | Epilachnini (not recorded from the study area) | |
| 6' | | Body length 1.5-3.5 mm. Mandibles simple or bifid | 7 |
| 7 | (6') | Body elongate, oblong. Front coxal cavities open posteriorly | |
| | | Coccidulini, p. | 295 |
| 7' | | Body oval, convex. Front coxal cavities closed posteriorly | 8 |
| 8 | (7') | Prosternum projected anteriorly to partially cover mouthparts | |
| | | Stethorini, p. | 295 |

- 8' Anterior margin of prosternum straight, not projected anteriorly
 Scymnini, p. 296

Key to adults of the coccinellid genera of western Canada and Alaska

Tribe Sticholotini

- 1 Single genus only *Microweisea* Cockerell, p. 296

Tribe Stethorini

- 1 Single genus only *Stethorus* Weise, p. 297

Tribe Scymnini

- 1 (0) Metacoxal arcs incomplete, not curved anteriorly, paralld laterally to sternal margin. Prosternum carinate. Tarsal formula 3-3-3. Antenna of 10 articles *Nephus* Mulsant, p. 306
 1' Metacoxal arcs various, recurved anteriorly. Tarsal formula 4-4-4 2
 2 (1') Metacoxal arcx incomplete, semicircular. Ultimate article of maxillary palpus securiform, much wider than penultimate article. Antenna of 11 articles. Pronotum with sides continuous in outline with elytra
 *Scymnus* (*Scymnus*) Kugelann, p. 300
 2' Metacoxal arcs complete 3
 3 (2') Ultimate article of maxillary palpus securiform
 *Scymnus* (*Pullus*) Mulsant, p. 303
 3' Ultimate article of maxillary palpus slender, only slightly wider than penultimate article. Pronotum with sides markedly narrower than base of elytra .
 *Didion* Casey, p. 299

Tribe Hyeraspini

- 1 (0) Front leg with anterior margin of tibia spinose (Fig. 176)
 *Brachiacantha* Dejean, p. 317
 1' Front leg with tibia normal, slender 2
 2 (1') Anterior margin of mentum cordiform, epipleuron foveate for reception of hind femur (Fig. 174) *Hyeraspis* Dejean, p. 309
 2' Anterior margin of mentum straight, epipleuron not foveate
 *Hyeraspidius* Crotch, p. 308

Tribe Chilocorini

- 1 (0) Tarsal claws appendiculate 2
 1' Tarsal claws simple *Brumoides* Chapin, p. 320
 2 (1') Antenna of 10 articles *Exochomus* Redtenbacher, p. 319
 2' Antenna of 8 articles *Chilocorus* Leach, p. 318

Tribe Coccidulini

- 1 Single genus only *Coccidula* Kugelann, p. 321

Tribe Coccinellini

- 1 (0) Distal end of middle and hind tibiae each with single or paired spur 2
 1' Distal end of middle and hind tibiae without spurs, tarsal claw appendiculate, each with subquadrate basal tooth *Mulsantina* Weise, p. 350

- 2 (1) Distal end of middle and hind tibiae each with single spur only. Tarsal claws simple, swollen at base *Anisosticta* Dejean, p. 351
- 2' Distal end of middle and hind tibiae each with paired, prominent spurs ... 3
- 3 (2') Tarsal claws appendiculate or cleft, bifid 4
- 3' Tarsal claws simple, swollen at base. Body markedly elongate
..... *Macronaemia* Casey, p. 349
- 4 Pronotum shagreened, isodiametric meshes between punctures well developed (Fig. 79, 80) 5
- 4' Surface of pronotum shiny, polished, without isodiametric meshes between punctures (Fig. 81) *Calvia* Mulsant, p. 326
- 5 (4) Femur extended beyond lateral margin of elytron. Tarsal claws cleft, bifid . 6
- 5' Femur not extended beyond lateral margin of elytron. Tarsal claws appendiculate, each with large subquadrate basal tooth 7
- 6 (5) Elytra mostly orange-yellow, except in melanic specimens, maculate with black spots or vittae (Fig. 55-57, 59-70). Frons with diamond, or crown-like, interocular yellowish-white spot or band *Hippodamia* Dejean, p. 338
- 7 (5') Pronotum mostly black, anterior angles with yellowish-white, trapezoidal spots. Frons with two well separated yellowish-white, interocular spots, or band. *Coccinella* Linnaeus, p. 330
- 7' Pronotum variously maculate, not as above 8
- 8 (7') Body large, prominently convex to subhemispherical (TL 6-12 mm) 9
- 8' Body medium size (TL 4-6 mm) 10
- 9 (8) Each tarsal claw with large, basal subquadrate tooth. Elytra not vittate, if maculate each elytron with black spots *Anatis* Mulsant, p. 322
- 9' Each tarsal claw cleft, bifid. Maculation of elytra vittate as in Fig. 39-41. . .
..... *Myzia* LeConte, p. 324
- 10 (8') Elytra concolorous, orange-red, without black maculation
..... *Cycloneda* Crotch, p. 330
- 10' Pronotum mostly black, with two basal white spots (Fig. 43); or in melanic specimens with elytra and pronotum mostly black, anterior angles of pronotum and elytral maculation orange-yellow *Adalia* Mulsant, p. 328

Tribe Psylloborini

- 1 Single genus only *Psyllobora* Dejean, p. 352

Genus *Microweisea* Cockerell

Microweisea Cockerell, 1903:38. Replacement name for *Smilia* Weise, 1891:288. Not Mulsant, 1850:502. Type-species: *Smilia felschei* Weise, 1891:288.

Smilia Weise, 1891:288. Not Germar, 1838. Preoccupied. Type-species: *Smilia felschei* Weise, 1891:288. (= *Pentilia ovalis* LeConte, 1878:400). Designated by Weise, 1891:288; through monotypy.

Epismilia Cockerell, 1900:606. Replacement name for *Smilia* Weise, 1891. Not Fromental, 1861. Preoccupied.

Pseudoweisea Schwarz, 1904:118. Misquotation, unnecessary replacement name for *Smilia* Weise.

Comparison. — Small size, largest not longer than 1.5 mm, and obliquely impressed line on front angles of pronotum (Fig. 1), distinguish members of this genus from other coccinellids recorded from the study area.

Description. — Stichotoline adults of minute size (1.0 - 1.5 mm). Body ovoid, prominently convex to subhemispherical. Color: dorsal surface brown to black; ventral surface and legs brown to black. Vestiture: dorsal surface with pubescence short, sparse and indistinct. Sculpture: head finely punctate, frons shagreened; pronotum distinctly punctate, isodiametric meshes well impressed in members of some species, and when viewed under microscope (50x) microsculpture distinctly reticulate; elytra distinctly punctate, punctures uneven. Head: labrum expanded laterally; antenna of 11 articles, relatively short; maxillary palpus conical. Thorax: pronotum convex; margins with impressed line, obliquely at anterior angles (Fig. 1). Elytra: margins and suture narrowly beaded. Abdomen: metacoxal arcs absent. Legs: tarsal formula 4-4-4, claws appendiculate.

Distribution. — North America, genus with six species included.

Natural history. — Both larvae and adults are specialized as predators upon armored scales (Diaspinae). In the Prairie Region, Sharma and Martel (1972) reported adults and larvae to feed on pine needle scale *Phenacaspis pinifoliae* (Fitch).

Key to adults of the species of *Microweisea* from western Canada and Alaska

- | | | | |
|---------|--|-----------------------------------|-----|
| 1 (0) | Pronotal microsculpture reticulate; elytra distinctly punctate, punctures large | <i>M. misella</i> (LeConte), p. | 297 |
| 1' | Pronotal microsculpture indistinct, surface polished. Elytra indistinctly punctate, punctures fine | <i>M. marginata</i> (LeConte), p. | 297 |

Microweisea marginata (LeConte)

Pentilia marginata LeConte, 1878:400. Type locality: "Marquette, Lake Superior." Type in MCZ, not studied.

Comparison. — Distinguished from *M. misella* by characters given in the above key.

Description. — Habitus and maculation as in Fig. 1. Body minute, ovoid in outline; prominently convex. Color: head castaneous brown; antenna and mouthparts light brownish-yellow; ventral surface and legs brown-black, pronotum and elytra castaneous brown. Sculpture: pronotal anterior angles with obliquely impressed line; dorsal surface shallowly punctate, shiny; isodiametric meshes between punctures shallow, punctures of elytra evenly spaced, shallow, indistinct. TL 1.1 - 1.4 mm; W 0.7 - 0.8 mm.

Distribution. — Widely ranging in North America. Recorded from: Alberta, British Columbia, Idaho, Manitoba, Michigan, Montana, Ontario, Oregon, Saskatchewan, Quebec, and Washington.

Collecting and natural history notes. — Habitat: coniferous forest and parkland, on pines infested with *Phenacaspis pinifoliae* (Fitch). Univoltine, overwinters as 3rd larval instar (Sharma and Martel, 1972).

Number of specimens examined. — 10.

Microweisea misella (LeConte)

Pentilia misella LeConte, 1878:400. Type locality: None specified. Type in MCZ, not studied.

Comparison. — Distinguished from *M. marginata* by characters given in the above key.

Description. — Habitus and maculation as in Fig. 1. Body minute, ovoid in outline; prominently convex. Color: head brown-black; antennae and mouthparts brown; pronotum and elytra brown-black and shiny; ventral surface and legs brown-black. Sculpture: head punctate, elytra distinctly; pronotal microsculpture reticulate; anterior angles of pronotum with obliquely impressed line (Fig. 1). TL 1.0 - 1.4 mm; W 0.7 - 0.8 mm.

Variation. — Color: varied, from light brown to brown-black.

Distribution. — Widely ranging in North America, Fig. 88. Recorded from: Alabama, Alberta, Arizona, British Columbia, California, Connecticut, Dakotas, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Manitoba, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, New York, North Carolina, Ohio, Ontario, Oregon, Pennsylvania, Saskatchewan, South Carolina, Utah, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: coniferous and mixed forest, parkland.

Number of specimens examined. — 36.

Genus *Stethorus* Weise

Stethorus Weise, 1885:65. Type-species: *Coccinella minima* Rossi, 1794:89. (= *Stethorus punctillum* Weise, 1891:781). Subsequently designated by Korschefsky, 1931:111.

Derivation of name. — From Greek, "breast+margin" in reference to shape of prosternum.

The North American species of this genus have been studied by Casey (1899) and Brown (1950). Dobzhansky (1924) segregated this genus from Scymnini and erected tribe Stethorini. Kapur (1948) monographed the Old World species, and Sasaji (1971) provided an account of the Japanese species.

Comparison. — Anteriorly deflexed prosternum partially covering mouthparts readily separate adults of this genus from other Coccinellidae recorded from the study area.

Description. — Minute to small (1.0 - 1.8 mm) Stethorini. Body short to elongate oval, moderately to prominently convex. Color: most specimens entirely brown-black to black; antennae and mouthparts yellow to brown; tibiae and tarsi of members of some species yellow. Vestiture: dorsal surface pubescent; eyes with interfacetal hairs; ventral surface and legs setose. Sculpture: pronotum and elytra indistinctly punctate; ventral surface more distinctly punctate, especially basisternum. Head: antennae of 11 articles each, relatively short, clavate. Thorax: prosternum not carinate, anterior margin of basisternum markedly sinuate. Elytra: margins narrowly beaded; epipleura not foveate. Legs: normal, tibia slender, anterior edge not modified; tarsal formula 3-3-3, claws appendiculate. Abdomen: metacoxal arcs complete, semicircular. Male genitalia (figured by Kapur, 1948): lateral lobes very slender.

Distribution. — Northern Hemisphere. Genus with more than 10 species included, 3 species recorded from North America.

Natural history. — Both larvae and adults feed as specialized predators on tetranychid mites (Acarina). Kapur (1948) reviewed the literature on hosts of several Palaearctic *Stethorus* species. Bionomics of *S. punctillum* in North America was described by Putman (1955a). Collyer (1953) gave an account of bionomics of *S. punctillum* in England. Notes on natural history of *S. picipes* Casey were given by Newcomer and Yothers (1929), and *S. punctum* by Robinson (1953). The three North American *Stethorus* species overwinter as adults in leaf litter and cracks and crevices of trees which were the hosts for the tetranychid mites.

Key to adults of the species of *Stethorus* from western Canada and Alaska

- 1 (0) Mouthparts, antennae, tibiae and tarsi yellow *S. punctillum* Weise, p. 298
- 1' Legs entirely brown to black *S. picipes* Casey, p. 298

Stethorus picipes Casey

Stethorus picipes Casey, 1899:136. Type locality: "California." Type in USNM.

Comparison. — Distinguished from other North American *Stethorus* species by combination of characters: geographic range confined to western North America (Fig. 90); brown to black legs.

Description. — Habitus and maculation as in Fig. 2. Body minute, oval in outline prominently convex. Color: mostly black, except antennae and mouthparts yellow; femora, tibiae and tarsi brown to black. Sculpture: pronotum and elytra indistinctly punctate; punctuation of sterna more distinct. TL 1.0 - 1.3 mm; W 0.75 - 0.9 mm.

Variation. — Color: teneral specimens from yellow-brown to jet black in mature individuals. Color of legs varied, from yellowish-brown to black.

Distribution. — Pacific coast of North America, Fig. 90. Recorded from: California, southern British Columbia, Idaho, Oregon, and Washington

Collecting and natural history notes. — Recorded west of the Continental Divide, in interior British Columbia, in orchards infested with *Panonychus ulmi* (Koch), and *Tetranychus telarius* Linnaeus, (Tetranychidae). Beating and beating tray is one of the best techniques to collect these minute beetles.

Number of specimens examined. — 45.

Stethorus punctillum Weise

Stethorus punctillum Weise, 1891:781. Type locality: "Germany." Type not studied.

Comparison. — Distinguished from other North American *Stethorus* species by characters given in the above key. *S. punctum* and *S. punctillum* can be separated only on the basis of male genital armature, described by Brown (1950).

Description. — Habitus and maculation as in Fig. 2. Body minute, oval, prominently convex. Color: mostly black except, antennae and mouthparts yellow; dorsal and ventral surface brown-black; proximal ends of femora, tibiae and tarsi yellow. Immature stages described by Putman (1955b). TL 1.4 - 1.5 mm; W 1.0 mm.

Distribution. — Palearctic Region, introduced to North America. Recorded from: eastern coast (ca. 1900), western coast (ca. 1970); British Columbia, Washington, Idaho and Oregon.

Collecting and natural history notes. — Habitat: orchards, parkland. Most abundant west of the Cascade Mountains. In most instances, found with members of *S. picipes*.

Number of specimens examined. — 18.

Genus *Didion* Casey

Didion Casey, 1899: 134, 137. Type-species: *Didion longulum* Casey, 1899:137. Subsequently designated by Korschefsky, 1931:111.

Derivation of name. — origin unknown.

Comparison. — Distinguished from other North American Scymnini by combination of characters: body elongate oval (Fig. 3); pronotum with sides sub-parallel, narrower than elytra; ultimate article of maxillary palpus conical, obliquely truncate.

Description. — Scymnini of medium size (1.5 - 2.0 mm); Body elongate oval, convex. Color: head black, pronotum brown-black; elytra mostly black, maculate or not, if maculate each elytron with large, oval median spot; ventral surface and legs brown to black. Head: antennae of 11 articles each, relatively short, clavate; maxillary palpus of 3 articles, ultimate article conical, obliquely truncated; mandibles bifid at apex. Legs: normal, tarsal formula 4-4-4; claws appendiculate.

Distribution. — North America, with four species included.

Natural history. — Wingo (1952) reported *D. punctatum* to feed on two-spotted spider mites on cedar near Ames, Iowa.

Key to adults of the species of *Didion* from western Canada and Alaska

- | | | | |
|----|-----|---|---|
| 1 | (0) | Dorsal surface of elytra black, immaculate | 2 |
| 1' | | Elytra maculate, each elytron with reddish-orange discal spot | |
| | | <i>D. punctatum</i> (Melsheimer), p. 300 | |
| 2 | (1) | Pronotum distinctly punctate, punctures well impressed | |
| | | <i>D. nanus</i> (LeConte), p. 300 | |
| 2' | | Pronotum indistinctly punctate, punctures shallow | |
| | | <i>D. longulum</i> Casey, p. 299 | |

Didion longulum Casey

Didion longulum Casey, 1899:137. Type locality: "California (north of San Francisco)." Type in USNM.

Comparison. — Distinguished from *D. nanus* by indistinct punctuation of pronotum; geographic distribution—range west of the Continental Divide (Fig. 89); details of male genital armature (compare with *D. nanus*, figured by Wingo, 1952).

Description. — Habitus and maculation as in Fig. 3. Body elongate oval, oblong. Color: head black; mouthparts and antennae brown; pronotum black and shiny; anterior angles and margin rufescent; elytra black, non-maculate; ventral surface brown-black; tibiae and tarsi rufescent, brownish-yellow. Vestiture: normal for genus. Sculpture: average for genus, see above key. TL 1.5 - 1.8 mm; W 0.9 - 1.1 mm.

Distribution. — Western North America, Fig. 89. Recorded from: Alberta, British Columbia, California, Idaho, Oregon, Washington, and Yukon.

Collecting and natural history notes. — Habitat: trees, shrubs and other plants infested with spider-mites.

Number of specimens examined. — 45.

Didion nanus (LeConte)

Scymnus nanus LeConte, 1852:141. Type locality: "Missouri Territory." Type in MCZ, not studied.

Comparison. — Distinguished from other North American *Didion* species by combination of characters: immaculate elytra; distinct punctation of pronotum; details of male genital armature (figured by Wingo, 1952).

Description. — Habitus and maculation generally as in Fig. 3. Oval, convex. Color: head dark brown to black, paler toward clypeus; pronotum black with rufescent apical angles; elytra black, except apices paler. Sculpture: elytral microsculpture coarser than that on pronotum. Male genitalia (figured by Wingo, 1952): basal lobe considerably shorter than lateral lobes. TL 1.2 - 1.5 mm; W 1.0 - 1.5 mm.

Distribution. — Widely ranging in North America. Recorded from: Arizona, California, Illinois, Florida, Iowa, Michigan, Nebraska, New Mexico, and Ohio.

Collecting and natural history notes. — This species was not collected in the study area, but its occurrence here is expected.

Number of specimens examined. — 2.

Didion punctatum (Melsheimer)

Scymnus punctatus Melsheimer, 1847:180. Type locality: "Pennsylvania." Type not studied.

Comparison. — Distinguished from other North American *Didion* species by maculate elytra; each elytron with red-orange discal spot.

Description. — Habitus and maculation as in Fig. 4. Elongate oval, oblong. Color: head, pronotum and elytra black; each elytron with median red-orange spot; ventral surface mostly black, except femora and tibiae brown-black, and tarsi and mouth-parts pale brown. Sculpture: punctation of elytra more distinct than that of pronotum. TL 1.5 - 1.8 mm; W 1.0 - 1.2 mm.

Variation. — The red spot on each elytron is quite varied in size and shape.

Distribution. — Widely ranging in North America. Recorded from: Alberta, Dakotas, Illinois, Iowa, Kansas, Manitoba, Minnesota, Missouri, Ohio, Pennsylvania, Saskatchewan, Texas, and Wisconsin.

Collecting and natural history notes. — The two specimens known from southern Alberta were collected at Medicine Hat (Fig. 89).

Number of specimens examined. — 2.

Scymnus (sensu stricto) Kugelann¹.

Scymnus Kugelann, 1794:545, 546. Type-species: *Scymnus nigrinus* Kugelann, 1794:548. Subsequently designated by Korschefsky, 1931:115.

Note on type species. — The designation of *Coccinella frontalis* Fabricius, 1787:60, by Crotch (1874:239) is invalid. This species was not among the originally included species, and therefore cannot serve as the type-species.

Derivation of name. — From Greek, meaning lions' cub, in reference to resemblance of these pubescent beetles to little lions.

Systematic studies. — The North American species of this genus have been studied by: Horn (1895); Casey (1899); Wingo (1952). The genus was recently revised on the continental basis by Gordon (1976). The Japanese species were monographed by Sasaji (1971). Mader (1924) provided keys to European species.

Comparison. — Distinguished from other North American Scymninae by: antennae of 11 articles; distinct prosternal carinae; and metacoxal arcs incomplete, subparallel with sternal margin.

Description. — Body small to medium in size, short oval to elongate, moderately convex. Color: predominantly black, brown to rufo-flavate. Pronotum, elytra, and legs in members of some species orange-yellow to reddish-orange. Vestiture: both dorsal and ventral surface, including legs generally profusely pubescent. Sculpture: frons indistinctly to prominently

1. Gordon's revision (1976) appeared after the present incomplete treatment of Scymnini was in press. Accordingly, it was not possible to make changes in the latter. Those wishing to identify scymnine adults are advised to consult Gordon's paper. —Ed.

punctate, pronotum generally distinctly punctate; elytra prominently punctate, punctures in members of some species very prominent. Head: transverse with rounded corners; eyes normal, not prominently emarginate by post antennal processes; antennae of 11 articles each. Ultimate article of maxillary palpus longer than wide. Thorax: prosternum T-shaped, with or without distinct carinae. Legs: normal, moderately stout and short; tarsal formula 4-4-4, article 3 greatly reduced, claws appendiculate.

Variation. — Color: head in members of some species yellow in males, light brownish-yellow in females but this is not constant (Horn, 1895). Elytra vary in outline from species to species, dorsal surface covered densely to sparsely with punctures and pubescence. In species with maculate elytra extent of maculation varied. The shape of tarsal claws varies between species and in some species between sexes.

Distribution. — World wide group, with more than 200 species included of which 82 are recorded from North America (Gordon, 1976).

Natural history. — Members of this group are predaceous on scale insects and mites, both as larvae and adults.

Species not studied. — The following species, specimens of which I did not see, were reported from southern British Columbia by Gordon (1976): *Scymnus* (*S.*) *fenderi* Malkin.

Key to adults of some species of *Scymnus* (*Scymnus*) from western Canada and Alaska

- | | | | |
|----|-----|---|------------------------------------|
| 1 | (0) | Pronotum and elytra mostly black | 2 |
| 1' | | Pronotum and elytra rufoflavate | <i>S. phelpsi</i> Crotch, p. 302 |
| 2 | (1) | Elytra entirely black or only apices narrowly rufescent | 3 |
| 2' | | Elytra with apical 0.25-0.33 orange-brown | <i>S. opaculus</i> Horn, p. 302 |
| 3 | (2) | Body short oval, apex not distinctly orange-brown. Sterna brown-black | 303 |
| | | | <i>S. caurinus</i> Horn, p. 303 |
| 3' | | Body elongate oval, apex of elytra narrowly orange-brown. Sterna orange-brown | 4 |
| 4 | (3) | Basal lobe of male genitalia longer than lateral lobes, parallel sided for basal 0.66, constricted to blunt point. Lateral lobes triangular, broader at base. Siphon with fish hook-like projection at apex | <i>S. paracanus</i> Chapin, p. 302 |
| 4' | | Basal lobe longer than lateral lobes, broad basally, gradually rounded at apex. Lateral lobes elongate oval, slightly broader at base. Siphon with fish hook-like projection at apex | <i>S. apicanus</i> Chapin, p. 301 |

Scymnus (*Scymnus*) *apicanus* Chapin

Scymnus (*Scymnus*) *apicanus* Chapin, 1973: 1071. Type locality: "Ascension Parish, Louisiana." Type in USNM.

Scymnus (*Scymnus*) *apicanus borealis* Gordon, 1976: 38.

Comparison. — Distinguished from other North American *Scymnus* species by: general habitus and maculation; details of male genital armature (siphon with fish-hook like projection at apex); range extensive, but only east of the Rocky Mountains (Fig. 92).

Description. — Habitus and maculation as in Fig. 5. Color: head, mouthparts, and antennae reddish yellow; pronotum reddish orange with median arcuate black spot at base, extended anteriorly 0.80 of length; elytra mostly black, narrowly reddish-yellow apically; ventral surface mostly black, except posternum black at middle, reddish yellow laterally; meso- and metasternum black; abdomen with first 3 sterna black medially, pale laterally, remainder reddish yellow; legs reddish yellow. Male genitalia (figured by Chapin, 1973): basal lobe little longer than lateral lobes, broad at base, gradually rounded to a point at apex; each lateral lobe fringed with setae except at basal half of dorsal edge. Siphon with fish-hook like projection at apex. TL 2.1 - 2.6 mm; W 1.6 - 1.9 mm.

Variation. — There is some variation in size of pronotal spot, width of yellow band at apical edge of elytra, and extent of black on abdominal sterna.

Distribution. — Widely ranging in North America, Fig. 92. Recorded from: Alberta, Iowa, Manitoba, Minnesota, Saskatchewan, and Wisconsin.

Collecting and natural history notes. — Habitat: grassland and parkland of southeastern Alberta.

Number of specimens examined. — 6.

Scymnus (Scymnus) paracanus Chapin

Scymnus (Scymnus) paracanus Chapin, 1973:1071. Type locality: "Shangaloo, Louisiana." Type in USNM.

Scymnus (Scymnus) paracanus linearis Gordon, 1976: 44.

Comparison. — Distinguished from other North American *Scymnus* species by: general habitus and maculation (Fig. 5), see the above key; shape of lateral and basal lobes of male genital armature (figured by Gordon, 1976); size (TL 2.4-2.8 mm).

Description. — Habitus and maculation as in Fig. 5. Color: head, mouthparts, and antennae reddish yellow; pronotum reddish yellow with median arcuate black spot at base extended anteriorly 0.75 of length; elytra black, apical edges broadly reddish yellow; prosternum reddish yellow, darker between coxae; mesosternum and metasternum black, abdominal sterna reddish brown; legs reddish yellow. Male genitalia (figured by Chapin, 1973): basal lobe longer than lateral lobes, parallel sided for basal 0.66 narrowed to blunt point; each lateral lobe triangular, broader at base, figured with setae, except basal half of dorsal edge; siphon with fish-hook like projection at apex. TL 2.4 - 2.8 mm; W 1.7 - 1.9 mm.

Variation. — Color: width of yellow band at apex of elytra various.

Distribution. — Wide ranging in interior North America, Fig. 93. Recorded from: Alberta, Louisiana, southern Manitoba, Missouri, and southern Saskatchewan.

Collecting and natural history notes. — Habitat: grassland and parkland, within the study area apparently restricted to southeastern Alberta.

Number of specimens examined. — 16.

Scymnus (Scymnus) opaculus Horn

Scymnus opaculus Horn, 1895:96. Type locality: "Colorado." Type not studied.

Comparison. — Similar to *Scymnus (Pullus) postpictus* Casey but larger and distinguished by complete metacoxal arcs.

Description. — Habitus and maculation as in Fig. 6. Body elongate oval, convex. Color: head black: anterior margin orange-yellow; mouthparts and antennae orange-yellow; pronotum mostly black, except anterior angles orange-yellow; elytra mostly black, maculate at apical 0.33 to 0.50 with orange-yellow spots; ventral surface black, except sterna V-VI orange-yellow, legs orange-yellow. TL 1.8 - 2.3 mm; W 1.5 mm.

Distribution. — Widely ranging in North America, Fig. 94. Recorded from: southern Alberta, southern British Columbia, Colorado, Idaho, Illinois, Indiana, Michigan, Minnesota, Montana, North Dakota, Ohio, Saskatchewan, Wisconsin, and Wyoming.

Collecting and natural history notes. — Habitat: parkland, savannas, grassland, and prairie of southern British Columbia and Alberta.

Number of specimens examined. — 25.

Scymnus (Scymnus) phelpsi Crotch

Scymnus phelpsi Crotch, 1874a:77. Type locality: None specified, "Victoria and New Westminster." Type not studied.

Comparison. — Distinguished from other North American species in this genus by: general habitus and maculation (Fig. 7); size (TL 1.7-2.7 mm); distribution—range in western North America (Fig. 91); details of male genital armature (figured by Gordon, 1976).

Description. — Habitus as in Fig. 7. Body short oval, moderately convex. Color: head, pronotum and elytra rufotestaceous; ventral surface, meso- and metasterna and basal abdominal sterna black, except legs rufotestaceous. Vestiture: normal for genus. Sculpture: normal for genus, head and pronotum sparsely punctate, punctures of elytra larger. TL 1.7-2.7 mm; W 1.0-1.7 mm.

Distribution. — Western North America, Fig. 91. Recorded from: southern British Columbia, California, Nevada, western Washington, Oregon and southwestern Idaho.

Collecting and natural history notes. — Habitat: parkland, chaparral, in coastal British Columbia.

Number of specimens examined. — 28.

Scymnus (Scymnus) caurinus Horn

Scymnus caurinus Horn, 1895:97. Type locality: none specified. Type not studied.

Comparison. — Distinguished from other North American species by: general habitus and maculation, size (TL 2.0-2.6 mm); geographic distribution—range in western North America.

Description. — Habitus and maculation generally similar to *S. lacustris* (Fig. 7). Body broadly oval, convex, outline continuous. Color: entirely piceous, except in some specimens, frons and lateral margins of pronotum orange-yellow. Legs reddish-yellow. Vestiture: normal for genus. Sculpture: head sparsely punctate, pronotum finely but sparsely punctate; elytra distinctly but not closely punctate; sterna densely punctate. TL 2.0 - 2.6 mm; W 1.4 mm.

Distribution. — Western North America. Recorded from: southern British Columbia, California, Idaho, Oregon, Utah and Washington.

Collecting and natural history notes. — Habitat: chaparral communities in southern British Columbia.

Number of specimens examined. — 12.

Scymnus (Pullus) Mulsant

Pullus Mulsant, 1846:241. Type-species: *Coccinella subvillosa* Goeze, 1777:247. Subsequently designated by Korschefsky, 1931:116.

Derivation of name. — From Greek, *Pullus* = “a young bird in the downy stage”, presumably in reference to small size, and pubescent body.

Comparison. — Distinguished from *Scymnus (sensu stricto)* by: complete metacoxal arcs, extended to basal margin of sternum IV. Sasaji (1971) pointed out that separation of *Pullus* and *Scymnus* is arbitrary, based on extent of variation in metacoxal arcs. Tentatively, I follow segregation of *Pullus* from *Scymnus (sensu stricto)* until results from further study of this group provide evidence to the contrary.

Systematic studies. — The North American species of this group have been studied by: Horn (1895); Casey (1899); Wingo (1952); and revised on a continental basis by Gordon (1976). The Japanese species were monographed by Sasaji (1971).

Species not studied. — I did not see specimens of the following species, which Gordon (1976) reported from southern British Columbia: *S. (P.) humboldti* Casey, *S. (P.) iowensis* Casey, *S. (P.) erythronotum* Gordon, *S. (P.) aridus* Casey, and *S. (P.) impletus* Gordon.

Key to adults of some species of *Scymnus (Pullus)* from western Canada and Alaska

- | | | | |
|----|-----|---|-----|
| 1 | (0) | Elytra mostly black, if pigmented only apices yellow-orange | 2 |
| 1' | | Elytra mostly orange-brown, lateral margins, base, and suture brown. Pronotum mostly brown, except anterior angles orange-brown | |
| | | <i>S. (P.) coniferarum</i> Crotch, p. | 305 |
| 2 | (1) | Elytra almost entirely black, except apices narrowly margined yellow-orange, or rufescent | 3 |
| 2' | | Elytra mostly black, except apical 0.33 maculate with large, yellow-orange oval spots. Pronotum mostly yellow-orange, maculate with semicircular basal black spot | |
| | | <i>S. (P.) postpictus</i> Casey, p. | 304 |
| 3 | (2) | Pronotum mostly yellow-orange, maculate with basal black spot, or black with anterior angles orange-brown | 4 |
| 3' | | Head, pronotum and legs uniformly yellow-orange | |
| | | <i>S. (P.) carri</i> Gordon, p. | 304 |
| 4 | (3) | Legs bicolored; femora brown-black, except distal end; tibiae and tarsi yellow-orange | 5 |
| 4' | | Legs brown-black. Pronotum mostly yellow-orange, maculate with basal black spot. Males with setigerous tubercle on sternum III | |
| | | <i>S. (P.) marginicollis</i> Mann, p. | 304 |

- 5 (4) Sternum III of male with polished median spot, surrounded by dense setation. Sternum VI with pronounced depression in middle
 *S. (P.) lacustris* LeConte, p. 305

Scymnus (Pullus) postpictus Casey

Scymnus postpictus Casey, 1899:141. Type locality: "Wyoming." Type in USNM.

Comparison. — Distinguished from other North American species by: general habitus and maculation (pronotum with wide, yellowish-orange, lateral margins, elytra black, except apical 0.33 maculate with large, oval yellowish-orange spots); size (TL 1.8-2.3 mm); geographic distribution—range in western North America (Fig. 95).

Description. — Habitus and maculation as in Fig. 6. Body elongate oval, convex. Color: head orange-yellow to brown; mouthparts and antennae yellow; pronotum orange-yellow with black median spot at base; elytra mostly black, except apical 0.33 with large, oval orange-yellow spot; ventral surface black, except legs orange-yellow. TL 1.8 - 2.3 mm; W 1.5 mm.

Variation. — Size of elytral maculation various.

Distribution. — Western North America, Fig. 95. Recorded from: Alberta, British Columbia, Idaho, Montana, Oregon, Saskatchewan, and Wyoming.

Collecting and natural history notes. — Habitat: grasslands and parkland.

Number of specimens examined. — 19.

Scymnus (Pullus) marginicollis Mannerheim

Scymnus marginicollis Mannerheim, 1843:313. Type locality: "California." Type not studied.

Scymnus (Pullus) marginicollis borealis Hatch, 1962:150. Type locality: "Walla Walla, Washington." Type not studied.

Comparison. — Similar to *S. ardelio* Horn, and *S. lacustris* LeConte, from which males are distinguished by small setigerous tubercle on sternum III.

Description. — Habitus and maculation as in Fig. 11. Body broadly oval, moderately convex. Color: head orange-yellow to black; mouthparts and antennae rufescent; pronotum mostly orange-yellow; elytra black; ventral surface brownish black, except legs dark brown to black, tarsi and tibio-femoral articles rufescent. TL 1.5 - 2.0 mm.

Variation. — Extent of pale coloration of head and pronotum varied: head orange-yellow to black, sexually dimorphic; males with head predominantly orange-yellow; pronotum entirely black to entirely orange-yellow; median dark area reduced in some specimens to narrow strip or basal spot.

Distribution. — Western North America, Fig. 100. Recorded from: southern Alberta, southern British Columbia, California, Idaho, Montana, Oregon, and Washington.

Collecting and natural history notes. — Collected beating *Pinus ponderosa* in coastal British Columbia.

Number of specimens examined. — 8.

Scymnus (Pullus) carri Gordon

Scymnus (Pullus) carri Gordon, 1976:199. Type locality: "Medicine Hat, Alberta." Type in USNM.

Comparison. — Distinguished from other North American scymnines recorded from the study area by: entirely orange-yellow head and pronotum, immaculate black elytra; size (TL 2.3 mm); restricted distribution range (recorded from Alberta and Saskatchewan only).

Description. — Habitus and maculation similar to Fig. 11. Body elongate oval, oblong. Color: head orange-yellow; mouthparts and antennae orange-yellow; pronotum entirely orange-yellow, elytra mostly black, except apices narrowly rufous; ventral surface (sterna) orange-yellow to dark brown; legs orange-yellow. TL 2.3 mm; W 1.8 mm.

Distribution. — Southern Alberta and Saskatchewan, Fig. 96.

Collecting and natural history notes. — Habitat: grasslands of southern Alberta and Saskatchewan.

Number of specimens examined. — 10.

Scymnus (Pullus) aquilonarius Gordon

Scymnus (Pullus) aquilonarius Gordon, 1976:240. Type locality: Diamond City, Alberta. Type in CNC.

For description, comparison and other details, see Gordon (1976). Described from single specimen, not studied by me.

Distribution. — Recorded from: southern Alberta only (Fig. 96).

Collecting and natural history notes. — Habitat: grasslands of southern Alberta.

Number of specimens examined. — none.

Scymnus (Pullus) lacustris LeConte

Scymnus lacustris LeConte, 1850:239. Type locality: "Lake Superior."

Scymnus tahoensis Casey, 1899:150. Type locality: "Lake Tahoe, California." Type in USNM. Synonymized by Gordon (1976: in press).

Comparison. — Distinguished from members of other North American *Pullus* species by: entirely black pronotum, bicolored legs and distinctly punctate pronotum and elytra.

Description. — Habitus and maculation as in Fig. 7. Body oval, oblong, pubescent. Color: head black; frons orange-yellow to brown-black; mouthparts and antennae orange-yellow; pronotum and elytra mostly black, except apical margins narrowly bordered orange-brown; ventral surface black, femora brown-black, distally orange-yellow; tibiae and tarsi orange-yellow.

TL 1.9 - 2.6 mm; W 1.5 - 1.7 mm.

Variation. — Extent of orange-yellow portion of frons varied, from very narrow anterior band to wide interocular band.

Distribution. — Widely ranging in North America, Fig. 99. Recorded from: Alberta, British Columbia, California, Dakotas, Idaho, Indiana, Manitoba, Michigan, Minnesota, Montana, Ontario, Oregon, Saskatchewan, Utah, Washington, and Yukon.

Collecting and natural history notes. — Habitat: grassland, xeric savannas, parkland.

Number of specimens examined. — 65.

Scymnus (Pullus) coniferarum Crotch

Scymnus coniferarum Crotch, 1874a:77. Type locality: None specified, "Calaveras, Tahoe, San Bernardino." Type not studied.

Comparison. — Distinguished from members of other North American *Pullus* species by: size (TL 1.5-1.9 mm); habitus and maculation (Fig. 23); and distribution range in western North America (Fig. 98).

Description. — Habitus and maculation similar to Fig. 10. Body elongate oval, convex. Color: pronotum black, front angles reddish; elytra rufotestaceous, suture narrowly black except extreme apex; elytral triangular maculation black, extended along basal margin and posteriorly along lateral margin; ventral surface and legs black. Abdomen: metacoxal lines semicircular. Size: TL 1.5 - 1.9 mm; W 0.8 - 1.1 mm.

Variation. — Color: extent of dark, pigmented area of elytra varied.

Distribution. — Western North America, Fig. 98. Recorded from: southern British Columbia, California, Idaho, Oregon and Washington.

Collecting and natural history notes. — Habitat: On pine trees infested with scale insects.

Number of specimens examined. — 12.

Scymnus (Pullus) ardelio Horn

Scymnus ardelio Horn, 1895:105. Type locality: None specified. Type not studied.

Comparison. — Distinguished from members of other North American *Pullus* species recorded from the study area by: dorsal surface of pronotum and elytra mostly black, except anterior angles of pronotum, and apices of elytra, narrowly bordered rufo-flavate. Ventral surface mostly black. Front legs and tibiae and tarsi of middle and hind legs orange-yellow.

Description. — Habitus and maculation as in Fig. 11. Body short oval, markedly convex. Color: head orange-yellow; mouthparts and antennae orange-yellow; pronotum black, except anterior angles and lateral margins orange-yellow; elytra mostly black, except apices narrowly bordered orange-yellow; ventral surface black. Legs orange-yellow, except hind femora brown-black. TL 1.8 - 2.5 mm; W 1.2 mm.

Distribution. — Western North America, Fig. 97. Recorded from: southern Alberta, southern British Columbia, California, Idaho, Montana, Oregon, Utah, and Washington.

Collecting and natural history notes. — Habitat: grassland; collected from *Artemisia* plants in southern Alberta.

Number of specimens examined. — 17.

Scymnus (Pullus) calaveras Casey

Scymnus calaveras Casey, 1899:150. Type locality: "Mokelumne Hill, Calaveras Co., California." Type in USNM.

Comparison. — Distinguished from members of other North American *Pullus* species by: general habitus and maculation range (Fig. 7); size (TL 2.1-2.2 mm); distribution in western North America (Fig. 101).

Description. — Habitus and maculation as in Fig. 7. Body oval, markedly convex. Color: head black; frons narrowly orange anteriorly; mouthparts and antennae light brownish-yellow; pronotum and elytra black; ventral surface black; distal ends of femora and tibiae and tarsi orange-brown. Vestiture: normal for the genus, pubescence rufous. Sculpture: normal for genus, elytra distinctly punctate. TL 2.1 - 2.2 mm; W 1.6 mm.

Distribution. — Western North America, Fig. 101. Recorded from: coastal California, southern British Columbia, Oregon, and Washington.

Collecting and natural history notes. — Habitat: coastal chaparral communities.

Number of specimens examined. — 18.

Nephus (sensu latiore) Mulsant¹.

Nephus Mulsant, 1846:237. Type-species: *Coccinella quadrimaculata* Herbst, 1783:30. (= *C. quadrilunata* Illiger, 1798:416). Subsequently designated by Korschefsky, 1931:116.

Derivation of name. — From Greek, *nephos* = cloud (dark colored); in reference to body color.

The North American species of this genus have been studied by Horn (1895), Casey (1899), Crotch (1873), and the group was recently revised on the continental basis by Gordon (1976). Sasaji (1971) provided an account of the Japanese species.

Comparison. — Tarsal formula 3-3-3, and ankylosed scape and pedicel of antennae readily distinguish members of this genus from other scymnines.

Description. — Body oval, moderately convex. Head: antennae each of 10 articles, scape and pedicel fused. Legs: tibial spurs absent; tarsal formula 3-3-3, claws each with acute basal tooth. Male genital armature (figured by Sasaji, 1971): basal lobe symmetrical.

Distribution. — Northern Hemisphere, transcontinental in North America. Genus with more than 100 species included.

Key to adults of the species of *Nephus* from western Canada and Alaska

- | | | | |
|----|-------|--|-----------------------------------|
| 1 | (0) | Elytron maculate with single ferrugineous to reddish-orange spot | 2 |
| 1' | | Elytron with two spots | 3 |
| 2 | (1) | Dorsal surface mostly piceous to ferrugineous, each elytron with relatively large oval, yellow-orange spot, extended from humeral angle almost to margin and suture, but not to apex. Base of elytra and suture brown-black. Legs orange-yellow to light brown | <i>N. sordidus</i> (Horn), p. 307 |
| 2' | | Dorsal surface mostly black, except elytron with small, reddish-orange spot in apical third. Ventral surface piceous, except legs rufotestaceous | <i>N. georgei</i> (Weise), p. 307 |

1. See footnote, p. 300.

- 3 (1') Elytron with two obliquely oval, relatively large, not well defined, orange-yellow spots. Spots in some specimens contiguous
 *N. ornatus* (LeConte), p. 307

Nephus ornatus LeConte

Scymnus ornatus LeConte, 1850:239. Type locality: "Lake Superior." Type in MCZ, not studied.

Scymnus naviculatus Casey, 1899:155. Type locality: "Colorado." Type in USNM. Synonymized by Gordon (1976:288).

Comparison. — Distinguished from members of other North American *Nephus* species by: general habitus and maculation (Fig. 22); size (TL 1.6-2.0 mm); details of male genital armature (figured by Gordon, 1976).

Description. — Habitus and maculation as in Fig. 22. Body oval, convex. Color: head black; mouthparts and antennae light brownish-yellow; pronotum and elytra black; each elytron with two, obliquely oval, orange-yellow spots; ventral surface black; femora brown, other articles of legs rufo-castaneous. TL 1.6 - 2.0 mm; W 0.8 - 1.2 mm.

Distribution. — Widely distributed in North America, Fig. 105. Recorded from: southern Alberta, southern British Columbia, Colorado, Illinois, Indiana, Iowa, Manitoba, Massachusetts, Minnesota, North Dakota, Ontario, Quebec, Saskatchewan, and Wisconsin.

Collecting and natural history notes. — Habitat: prairie, grassland, cultivated fields, and parkland.

Number of specimens examined. — 6.

Nephus georgei (Weise)

Scymnus bisignatus Horn, 1895:92. Type locality: "Siskiyou County, California." Type not studied.

Scymnus georgei Weise, 1929:33. New name.

Comparison. — Distinguished from adults of other North American *Nephus* species by details of male genital armature (see Gordon, 1976).

Description. — Habitus and maculation as in Fig. 8. Body oval, moderately convex. Color: mostly black, each elytron maculate with transversely oval red spot; ventral surface black; tibiae and tarsi rufotestaceous, femora light brownish-yellow. Sculpture: head indistinctly punctate; pronotum finely punctate; elytra coarsely but not closely punctate. Abdomen: metacoxal lines distant from sternal margin, not parallel with it, but slightly arcuate anteriorly. TL 1.5 - 1.7 mm; W 0.8 mm.

Distribution. — Western North America, Fig. 102. Recorded from: Alaska, Alberta, British Columbia, California, Oregon, Northwest Territories, and Yukon.

Collecting and natural history notes. — Habitat: parkland, boreal forest.

Number of specimens examined. — 12.

Nephus sordidus (Horn)

Scymnus sordidus Horn, 1895:93. Type locality: "Los Angeles, California." Type not studied.

Comparison. — Distinguished from adults of other species of *Nephus* by: general habitus and maculation (Fig. 9); male genitalia (see Gordon, 1976); and geographic range in western North America (Fig. 106).

Description. — Habitus and maculation similar as in Fig. 10. Elongate oval, convex. Color: light brownish-yellow; each elytron with large paler spot covering most of it. Sculpture: head and pronotum scarcely punctate, elytra more closely punctate. TL 1.5 - 2.0 mm; W 0.9 - 1.1 mm.

Variation. — Color: from ferrugineous to light brownish-yellow.

Distribution. — Western North America, Fig. 106. Recorded from: southern Alberta, Illinois, Indiana, southern Manitoba, Michigan, Minnesota, North Dakota, Ontario, South Dakota, and southern Saskatchewan.

Collecting and natural history notes. — Habitat: grasslands of southern Alberta and Saskatchewan.

Number of specimens examined. — 3.

Genus *Hyperaspidius* Crotch

Hyperaspidius Crotch, 1873:382. Type-species: *Chrysomela trimaculata* Linnaeus, 1767:592. Designated by Crotch, 1873:382; original designation.

Derivation of name. — Origin unknown, presumably named in reference to resemblance to *Hyperaspis*.

Comparison. — Distinguished from adults of other North American Hyperaspini by combination of characters: anterior margin of submentum straight; epipleura not foveate for reception of hind femora; front tibiae not spinose; tarsal claws simple (Fig. 182).

Description. — Habitus and maculation as in Fig. 16. Hyperaspini of small to medium size (1.0 - 4.0 mm). Body elongate oval, oblong. Color: from pale yellow, flavate to brown-black; maculate specimens with brown-black longitudinal vittae on pale yellow background of elytra; melanic specimens with pronotum and anterior angles of elytra yellow-orange, specimens of some species brown-black entirely. Vestiture: dorsal surface glabrous, ventral surface and legs setose. Sculpture: head finely punctate; pronotum shagreened; elytra shiny, punctures larger, unequal. Head: eyes narrowly emarginate, in adults of some species with greenish-blue lustre; antennae each of 11 articles, relatively short; mandibles bifid at apex; maxillary palpus of 3 articles, ultimate article trapezoidal. Pronotum and elytra compact; anterior margin of pronotum recessed above eyes, posterior margin narrowly beaded. Elytra: margins narrowly reflexed; suture narrowly beaded; apical angle nearly rectangular. Legs: front tibiae not modified or spinose; tarsal formula 4-4-4, claws simple (Fig. 182). Abdomen: metacoxal arcs complete or incomplete, semicircular (Fig. 179, 180).

Distribution. — North and Middle American genus with highest diversity in southwestern United States.

Natural history. — Very little is known about life histories for members of this genus. The following note was copied from label data: "On cottony cochineal scale of cactus; Phoenix, Arizona."

Key to adults of the species of *Hyperaspidius* from western Canada and Alaska

- | | | | |
|----|-----|--|--|
| 1 | (0) | Elytra yellow with three, longitudinal, black vittae | 2 |
| 1' | | Elytra brown-black | <i>H. arcuatus</i> (LeConte), p. 309 |
| 2 | (1) | Body length ca. 4.0 mm | <i>H. hercules</i> , n. sp., p. 308 |
| 2' | | Body length ca. 2.0 mm | <i>H. vittigerus</i> (LeConte), p. 309 |

Hyperaspidius hercules, new species

Hyperaspidius hercules, new species. Type locality: Medicine Hat, Alberta. Holotype: male, labelled - Holotype (red border, circular label). Medicine Hat, 03.VII.1932. F.S. Carr collector. Deposited in CNC. Paratypes: two males, three females; labelled - Paratype (yellow border, circular label). Deposited in UASM.

Derivation of specific epithet: named in reference to size, largest member of genus.

Comparison. — Distinguished from other North American members of this genus by: large size (TL 3.8-4.0 mm), maculation of pronotum and elytra (Fig. 12), and restricted geographic range in northern, western North America (Fig. 104).

Description. — Habitus and maculation as in Fig. 10. Body elongate oval, oblong. Color: head brown-black, anterior margin of frons orange-brown; eyes finely faceted, with bluish lustre; mouthparts and antennae yellow-brown; pronotum mostly black, except lateral margin widely, and anterior narrowly bordered yellow; scutellum black; elytra yellow, each elytron with longitudinal discal vitta, dark brown to black in color; extended from humeral callus posteriorly, joined to sutural vitta before apex, and at apex joined to lateral emargination; ventral surface and legs rufous to light brown. Abdomen: metacoxal arcs complete. Male genital armature (Fig. 170B, 170C, 170D): median lobe slender arcuate tube, siphonal capsule present; basal lobe asymmetrical, shorter than lateral lobes. Female genital armature (Fig. 170A): spermatheca retort-shaped. TL 4.0 mm; W 3.5 mm.

Variation. — Color: head dark brown in females, yellow in males.

Note on relationship. — This species is most closely related to *H. insignis*, based on size, and the shape of basal lobe of male genital armature (Fig. 170D).

Distribution. — Western North America, Fig. 104. Recorded from: southern Alberta and Montana.

Collecting and natural history notes. — Habitat not known. In the study area restricted to southeastern Alberta. Type material was collected during June and July.

Number of specimens examined. — 6.

Hyperaspidium vittigerus (LeConte)

Hyperaspis vittigera LeConte, 1852:133. Type locality: "Missouri." Type in MCZ, not studied.

Hyperaspidium trimaculatus: Crotch, 1873:873. Not Linnaeus, 1762. Misidentification.

Hyperaspidium oblongus Casey, 1908:421. Type locality: "El Paso, Texas." Type in USNM. Synonymized by Wingo, 1952:26.

Hyperaspis wolcottii Nunenmacher, 1911:74. Type locality: "Buffington, Indiana." Type in CAS. Synonymized by Wingo, 1952:26.

Comparison. — Distinguished from other North American members of this genus by medium size (TL 1.9-2.2 mm), maculation (Fig. 12), and transcontinental range (Fig. 107) in North America.

Description. — Habitus and maculation as in Fig. 12. Body elongate oval, oblong. Color: head dark brown, mouthparts and antennae light brownish-yellow; pronotum brown, lateral margins yellow; elytra yellow, each with longitudinal, brown-black vitta, connected to sutural vitta before apex; sutural vitta expanded at middle, apex narrowly emarginated brown-black. Sculpture: dorsal surface punctate, ventral surface and legs light brown, punctation distinct, without isodiametric meshes between punctures. TL 1.9 - 2.2 mm; W 1.2 - 1.4 mm.

Variation. — Color: head black in females, yellow in males.

Distribution. — Widely ranging in North America, Fig. 107. Recorded from: Alberta, British Columbia, California, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Manitoba, Montana, Minnesota, New Brunswick, New Jersey, New York, North Dakota, Nova Scotia, Ontario, Oregon, Ohio, Quebec, Saskatchewan, Texas, Utah, Virginia, Washington, Wyoming, and Yukon.

Collecting and natural history notes. — Habitat: grasslands of southern Alberta, also parkland and savannas. Most abundant in the southern portion of the study area.

Number of specimens examined. — 65.

Hyperaspidium arcuatus (LeConte)

Hyperaspis arcuata LeConte, 1852:133. Type locality: "Gila River, California." Type in MCZ, not studied.

Comparison. — Similar to *H. immaculatus* Hatch, specimens of which are on average larger, and differ in suffused maculation.

Description. — Habitus and maculation as in Fig. 16. Body elongate oval, oblong. Color: head yellow, vertex black; eyes with bluish-green lustre; mouthparts and antennae light brownish-yellow; pronotum and elytra dark brown; each elytron maculate with relatively small, yellow-orange lunate spot at humeral angles; margin and suture pigmented darker; ventral surface and legs light brownish-to dark brown; legs paler than sterna. Abdomen: metacoxal arcs complete. TL 1.8 - 2.0 mm; W 0.9 - 1.0 mm.

Variation. — Color: head black-brown in females, yellow marks on pronotum and elytra indistinct.

Distribution. — Pacific coast of North America, Fig. 103. Recorded from: British Columbia, California, Oregon, and Washington.

Collecting and natural history notes. — Habitat unknown.

Number of specimens examined. — 5.

Genus *Hyperaspis* Dejean

Hyperaspis Dejean, 1836:459. Type-species: *Coccinella reppensis* Herbst, 1783:48. Subsequently designated by Crotch, 1874:213.

Oxynychus LeConte, 1850:694. Synonymized by Mulsant, 1850:238. Type-species: *Oxynychus moerens* LeConte, 1850:238. Fixed by monotypy. The subsequent designation of *Coccinella erythrocephala* Fabricius, 1787:61; by Korschefsky (1931:200), is invalid.

Note on synonymy. — Dobzhansky (1941:78) treated *Oxynychus* as congeneric with *Hyperaspis*, and pointed out that simple tarsal claws have developed independently in several, not closely related sections of *Hyperaspis*, hence *Oxynychus* does not represent a natural group. Günther (1959) stated that the representatives of the above mentioned genera can not be segregated on the basis of structure of male genital armature, or any other structural character other than simple tarsal claws, and treated *Oxynychus* as a subgenus of *Hyperaspis*. Miyatake (1961) reached the same conclusion and followed Günther's example.

Derivation of name. — From Greek, *hyper* + *aspis*, = excess + shield, in reference to shape of pronotum. First used by Dejean (1836), who credited its origin to Chevrolat.

Comparison. — Distinguished from other North American Hyperaspini by asymmetrical basal lobe of male genital armature (Fig. 171A, 171B, 171C), aspinose anterior edge of front femora, foveate epipleura for reception of front and hind femora (Fig. 173, 174).

Description. — Small to medium sized (1.0 - 5.0 mm) Hyperaspini. Body oval to rounded oval in outline, convex to subhemispherical. Color: mostly black, maculate with yellow to orange spots and vittae; color of head and pronotum sexually dimorphic, lighter in males, brown-black in females. elytral maculation (Fig. 13 - 30), basically, each elytron maculate with 5 yellow to orange spots, in adults of some species fused into vittae, or missing. Vestiture: dorsal surface glabrous, underside and legs setose. Microsculpture (Fig. 84, 87, 187, 188): both ventral and dorsal surfaces punctate; generally, punctuation of head finer than on pronotum and on pronotum finer than on elytra; ventral punctuation distinct, especially on meso- and metasternum, sterna (Fig. 188). Head: relatively small, eyes finely faceted, in adults of many species with bluish-green lustre; antennae (Fig. 175, 177, 178), relatively short, of 11 articles; mandibles bifid at apex, bicuspidate at base; maxillary palpus securiform; anterior margin of submentum cordiform; labial palpus relatively short, (Fig. 191) of 2 articles. Elytra: epipleura narrow, distinctly foveate for reception of front and hind femora (Fig. 174); prosternum carinate. Legs: relatively short, retractile (Fig. 173); tibiae slender, not spinose; tarsal claws appendiculate (Fig. 186 - 188), to simple in some species (Fig. 190). Male genital armature (Fig. 171A, 171B, 171C): basal lobe asymmetrical, lateral lobes setose distally, equal to or longer than basal lobe. Female genitalia (Fig. 171D): spermatheca of 2 vesicles, retort-shaped, connected by thin, tubular duct.

Distribution. — Worldwide except Australia and New Zealand. Number of described species: 335 for the world, (Korschefsky, 1931); 28 Palearctic Region (Iablokoff, 1971); 72 Nearctic Region (Dobzhansky, 1941). Fürsch (1972) reviewed the African fauna (54 species).

Natural history. — Predaceous upon aphids and coccids of *Pulvinaria*, *Pseudococcus*, and *Phenacoccus* species. Both adults and larvae of some species. e.g., *Hyperaspis reppensis*, were reported as inquilines in ants' nests (Wheeler, 1911; Mann, 1911).

Species not studied. — I did not see specimens of the following species, which may be expected to occur in southern Alberta or British Columbia: *Hyperaspis levrati* Mulsant and *H. annexa* LeConte.

Key to adults of the species of *Hyperaspis* from western Canada and Alaska

- | | | | |
|----|-----|---|---|
| 1 | (0) | Elytra mostly black, distinctly maculate with yellow to orange-yellow spots and/or vittae | 2 |
| 1' | | Elytra and pronotum brown-black, except traces of orange-brown maculation on lateral and anterior margins of pronotum and humeral angles of elytra. Alpine tundra of northern Rocky Mountains | <i>H. jasperensis</i> , n. sp., p. 316 |
| 2 | (1) | Each elytron maculate in addition to marginal vitta with distinct longitudinal discal vitta | 3 |
| 2' | | Each elytron maculate with marginal vitta or/and spots, in some specimens confluent with marginal vitta | 4 |
| 3 | (2) | Lateral margin of each elytron maculate with relatively narrow vitta extended to apex. Discal vitta extended diagonally across elytron, from humeral angle to apex. In some specimens feebly confluent with marginal vitta | <i>H. quadrivittata</i> LeConte, p. 313 |
| 3' | | Lateral margin of each elytron maculate with relatively narrow, abbreviated vitta, extended from humeral angle for 0.66 of length. Apex maculate with separate oval spot. Discal vitta abbreviated, extended diagonally from apex | |

- to mid-line *H. oregona* Dobzhansky, p. 314
- 4 (2') Each elytron maculate with apical spots only, or in some species with traces of marginal vitta at humeral angles 5
- 4' Each elytron maculate in addition to distinct marginal vitta with spots 6
- 5 (4') Each elytron maculate with single apical spot only *H. postica* LeConte, p. 312
- 5' Each elytron maculate with single apical spot, and traces of very abbreviated marginal vitta at humeral angles *H. elliptica* Casey, p. 313
- 6 (4') Marginal vitta abbreviated, not extended to apex 8
- 6' Marginal vitta not abbreviated, extended to apex 7
- 7 (6') Each elytron maculate with relatively wide marginal vitta only, extended from humeral angles to apex, shortly curved anteriorly *H. fimbriolata* (Melsheimer), p. 313
- 7' Each elytron maculate with relatively wide, sinuate marginal vitta, and single discal spot *H. undulata* (Say), p. 314
- 8 (6) Each elytron maculate in addition to marginal vitta with less than three spots each 9
- 8' Each elytron maculate in addition to relatively wide marginal vitta with three spots, arranged parallel to suture *H. levrati* Mulsant,
- 9 (8) Each elytron maculate in addition to abbreviated marginal vitta with two spots 10
- 9' Each elytron maculate in addition to abbreviated marginal vitta with single spot each 13
- 10 (9) Marginal vitta relatively wide 12
- 10' Marginal vitta relatively narrow 11
- 11 (10) Marginal vitta not sinuate, apical spot oval, smaller than discal spot *H. lugubris* (Randall), p. 316
- 11' Marginal vitta sinuate. Apical spot on each elytron round, relatively large, discal spot elongate oval (Fig. 27) *H. simulatrix* Dobzhansky, p. 315
- 12 (10) Each elytron maculate in addition to abbreviated, marginal vitta, with oval apical spot, and large discal spot (in some specimens confluent with marginal vitta). Maculation yellow-orange to orange *H. lateralis* Mulsant, p. 311
- 12' Each elytron maculate in addition to abbreviated marginal vitta with relatively large lunate apical spot, and elongate discal spot. Maculation ochreous-yellow. Spots in some specimens confluent longitudinally *H. fastidiosa* Casey, p. 312
- 13 (9') Marginal vitta relatively narrow, extended from humeral angel posteriorly 0.80. Apex of each elytron maculate with small, transverse oval spot *H. lanei* Hatch, p. 315
- 13' Marginal vitta extended posteriorly 0.60, distinctly tapered. Apex of each elytron maculate with small, oval spot *H. dissoluta* Crotch, p. 315

Hyperaspis lateralis Mulsant

Hyperaspis lateralis Mulsant, 1850:657. Type locality: "le Mexique." Type not studied.

Hyperaspis laevipennis Casey, 1899:122. Type locality: San Diego, California. Type in USNM. Synonymized by Dobzhansky, 1941:15.

Hyperaspis pinguis Casey, 1899:122. Type locality: "Arizona". Type in USNM. Synonymized by Dobzhansky, 1941:15.

Hyperaspis montanica Casey, 1899:121. Type locality: "western Montana". Type in USNM. Synonymized by Dobzhansky, 1941:16.

Hyperaspis wellmani Nunenmacher, 1911:72. Type locality: "Goldfield, Nevada." Type in CAS. Synonymized by Dobzhansky, 1941:18.

Hyperaspis idae Nunenmacher, 1912:450. Type locality: Guerneville, California. Type in CAS. Synonymized by Dobzhansky, 1941:19.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 17); size (TL 2.6-3.8 mm); details of male genital armature (figured by Dobzhansky, 1941); and geographic range in western North America (Fig. 108).

Description. — Habitus and maculation as in Fig. 17, 18, and 19. Body broadly oval, prominently convex. Color: in males head and mouthparts yellow, pronotum with lateral and anterior margins narrowly bordered yellow; in females head black, pronotum mostly black, with or without reddish anterior angles; elytral maculation yellow to red; marginal vitta extended for basal 0.40 broad, parallel sided; discal spot round to longitudinally oval; apical spot round to transversely oval; ventral surface black, except epimera white in males, black in females; front legs, tibiae and tarsi of middle and hind legs brownish-yellow in males, in females only tarsi so colored. Legs: tarsal claws appendiculate (Fig. 181, 185). Male genital armature: basal lobe shorter than lateral lobes, asymmetrical (figured by Dobzhansky, 1941). TL 2.6 - 3.8 mm; W 2.3 - 3.0 mm.

Variation. — Color and maculation: elytral maculation varied in extent and color from yellow to red; marginal vitta expanded and fused with enlarged discal spot; in some specimens vitta also coalescent with apical spot.

Distribution. — Western North America, Fig. 108. Recorded from: Alberta, Arizona, British Columbia, California, Colorado, Idaho, Mexico, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: grasslands and parkland of southern Alberta. Arboricole on trees and shrubs infested with mealybugs and aphids. Also collected from several species of *Artemisia*, and other herbaceous plants. Hosts: *Pseudococcus sequoiae*, *P. aurilatus*.

Number of specimens examined. — 135.

Hyperaspis fastidiosa Casey

Hyperaspis fastidiosa Casey, 1908:414. Type locality: San Diego, California. Type in CAS.

Hyperaspis fastidiosa septentrionis Dobzhansky, 1941:15. Type locality: Murtaugh, Idaho, Type in USNM (54201).

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 13); size (TL 2.1-2.7 mm); details of male genital armature (figured by Dobzhansky, 1941); and geographic range confined to western North America (Fig. 109).

Description. — Habitus and maculation as in Fig. 13. Body oval, prominently convex. Color: head yellow, vertex black; mouthparts and antennae yellow; pronotum mostly black, except lateral margins with large, quadrate mark; anterior margin yellow in males; elytra mostly black, each elytron maculate with lateral yellow vitta, posteriorly joined to subapical spot; anterior discal spot large, extended posteriorly and joined with subapical spot; basal margin, scutellum, and suture black; apices emarginate black; ventral surface light brown to brown-black; femora and tarsi light brownish-yellow, other articles darker. TL 2.1 - 2.7 mm; W 1.6 - 1.9 mm.

Variation. — Color: dimorphic, head in females black, vertex yellow in males; pronotum of males with yellow anterior margin, dilated medially to various degree; elytral maculation confluent to various degree.

Distribution. — Western North America, Fig. 109. Recorded from: Alberta, Arizona, British Columbia, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, and Wyoming.

Collecting and natural history notes. — Habitat: grasslands, parkland and xeric savannas in southern Alberta and British Columbia.

Number of specimens examined. — 38.

Hyperaspis postica LeConte

Hyperaspis postica LeConte, 1880:188. Type locality: "California."

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 24); size (TL 2.3-3.1 mm); details of male genital armature (figured by Dobzhansky, 1941); distribution confined to western North America (Fig. 110).

Description. — Habitus and maculation as in Fig. 24. Body elongate oval, moderately convex. Color: head black; mouthparts and antennae yellow; pronotum mostly black, except lateral margins bordered yellow-orange; elytra mostly black, maculate with single, orange-yellow oval, subapical spot each; ventral surface and legs brown-black; tarsi and tibiae distally, orange-brown. Sculpture: dorsal surface distinctly punctate, shiny; punctures unequal. Elytra: margins narrowly beaded; suture narrowly beaded. Legs: tarsal claws appendiculate. TL 2.3 - 3.1 mm; W 1.7 - 2.2 mm.

Distribution. — Western North America, Fig. 110. Recorded from: Alberta, Arizona, British Columbia, California, Idaho, Oregon, Utah, and Washington.

Collecting and natural history notes. — Habitat: grasslands and parkland in southern Alberta and British Columbia.

Number of specimens examined. — 28.

Hyperaspis fimbriolata Melsheimer

Hyperaspis fimbriolata Melsheimer, 1847:180. Type locality: "Pennsylvania." Type not studied.

Hyperaspis rufomarginata Mulsant, 1850:661. Type locality: "l'Amérique boreale." Type not studied. Synonymized by Dobzhansky, 1941:54.

Hyperaspis limbalis Casey, 1899:126. Type locality: San Diego, California. Type in USNM. Synonymized by Dobzhansky, 1941:54.

Hyperaspis inflexa Casey, 1899:126. Type locality: "Dakota". Type in USNM. Synonymized by Dobzhansky, 1941:56.

Hyperaspis serena Casey, 1908:417. Type locality: "Pennsylvania". Type in USNM. Synonymized by Dobzhansky, 1941:55.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 14); size (TL 2.3-2.8 mm); details of male genital armature (figured by Dobzhansky, 1941); transcontinental range in North America (Fig. 112).

Description. — Habitus and maculation as in Fig. 14. Body oval, moderately convex. Color: head yellow in males with median black stripe, pronotum mostly black with yellow lateral margin; in females head and pronotum entirely black; elytral maculation yellow to orange; marginal vitta basal 0.25, sinuate; legs brown to black, tibiae and tarsi yellowish in males. Sculpture: microsculpture of pronotum dense, and fine; that of elytra more pronounced. TL 2.3 - 2.8 mm; W 1.7 - 2.0 mm.

Distribution. — Widely ranging in North America, Fig. 112. Recorded from: Alberta, Arizona, British Columbia, California, Colorado, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, southern Manitoba, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Mexico, New York, North Dakota, North Carolina, Oregon, Pennsylvania, Texas, southern Saskatchewan, South Dakota, Utah, Virginia, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: grasslands, parkland and xeric savannas.

Number of specimens examined. — 45.

Hyperaspis quadrivittata LeConte

Hyperaspis quadrivittata LeConte, 1852:133. Type locality: "Long's Peak." Type not studied.

Hyperaspis tetraneura Casey, 1908:420. Type locality: "Boulder Co., Colorado." Type in USNM. Synonymized by Dobzhansky, 1941:75.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 22); size (TL 2.0-2.7 mm); distribution in western North America (Fig. 113).

Description. — Habitus and maculation as in Fig. 22. Body elongate oval, oblong. Color: head yellow in males with black vertex; in females black entirely; pronotum in both sexes with yellow lateral margins; elytra mostly black, maculate with yellow to whitish-yellow spots; marginal vitta extended posteriorly to apex, in some individuals united with discal vitta. TL 2.0 - 2.7 mm; W 1.3 - 1.8 mm.

Distribution. — Western North America, Fig. 113. Recorded from: Alberta, Arizona, British Columbia, Colorado, Idaho, Iowa, Montana, Nebraska, New Mexico, Utah, and Wyoming.

Collecting and natural history notes. — Collected only in southern British Columbia and Alberta.

Number of specimens examined. — 27.

Hyperaspis elliptica Casey

Hyperaspis elliptica Casey, 1899:126. Type locality: "California." Type in USNM.

Hyperaspis elliptica angustula Casey, 1899:127. Type locality: "Mendocino Co., California." Type in USNM. Synonymized

by Dobzhansky, 1941:40.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 23); size (TL 2.6-3.2 mm); distribution confined to western North America. Resembles *H. postica* from which it can be distinguished by larger size, more elongate outline and more distinct elytral microsculpture.

Description. — Habitus and maculation as in Fig. 23. Body outline oval, moderately convex. Color: head yellow in males with black median fascia; in females entirely black; pronotum in both sexes with yellow lateral margin; elytra mostly black, maculation yellow; apical spot transversely oval to triangular, closer to margin than to suture; ventral surface dark to light brownish-yellow; tibiae and tarsi yellowish in males, brown in females. TL 2.6 - 3.2 mm; W 1.6 - 2.0 mm.

Distribution. — Western North America, Fig. 111. Recorded from: Alberta, British Columbia, California, Montana, and Washington.

Collecting and natural history notes. — Habitat: grassland, parkland and savannas in southern Alberta and British Columbia.

Number of specimens examined. — 18.

Hyperaspis undulata (Say)

Coccinella undulata Say, 1824:92. Type locality: "Missouri." Type lost.

Hyperaspis maculifera Melsheimer, 1847:179. Type locality: "Pennsylvania." Type not studied. Synonymized by Dobzhansky, 1941:65.

Hyperaspis elegans Mulsant, 1850:658. Type locality: "l' Amerique boreale." Type not studied. Synonymized by Dobzhansky, 1941:65.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 25); size (TL 2.3-2.7 mm); wide range in North America; and details of male genital armature (figured by Dobzhansky, 1941).

Description. — Habitus and maculation as in Fig. 25. Body elongate oval, convex. Color: head black; pronotum mostly black, lateral margins orange-yellow; elytra mostly black, maculation orange-yellow; ventral surface dark brown; tibiae and tarsi light brownish-yellow, other articles dark brown. Vestiture: normal for genus. Sculpture: dorsal surface punctate, shagreened, punctures shallow; pronotum distinctly punctate, shiny; elytral punctures unequal, isodiametric meshes absent. TL 2.3 - 2.7 mm; W 1.4 - 1.9 mm.

Distribution. — Widely ranging in North America, Fig. 114. Recorded from: southern Alberta, southern British Columbia, Colorado, Dakotas, Kansas, Louisiana, Manitoba, Michigan, Minnesota, Nebraska, New Jersey, New York, Utah, and Texas.

Collecting and natural history notes. — Collected in southern Alberta and British Columbia.

Number of specimens examined. — 9.

Hyperaspis oregona Dobzhansky

Hyperaspis oregona Dobzhansky, 1941:76. Type locality: "Harney Co., Oregon." Type in USNM.

Hyperaspis oregona borealis Dobzhansky, 1941:76. Type locality: "Sonoma County, California." Type in USNM.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 20); size (TL 2.1-2.5 mm); range confined to western North America.

Description. — Habitus and maculation as in Fig. 20. Body elongate oval, oblong. Color: head black; antennae light brownish-yellow, mouthparts brown; pronotum mostly black, lateral margins narrowly bordered yellow; elytra mostly black, maculation orange-yellow; each elytron with narrow marginal vitta, extended from base for 0.80 of length; subapical spot oval; discal vitta narrow and abbreviated, only in posterior 0.50 of elytron; ventral surface and legs piceous to dark brown, tarsi and tibiae light brownish-yellow. Abdomen: metacoxal arcs complete, subparallel with sternal margin. TL 2.1 - 2.5 mm; W 1.5 - 1.7 mm.

Variation. — Males with frons and anterior margin of pronotum orange-yellow.

Distribution. — Western North America, Fig. 115. Recorded from: southern Alberta, southern British Columbia, Idaho, Montana, Oregon, Washington, and Wyoming.

Collecting and natural history notes. — Adults were collected in southern Alberta and

British Columbia.

Number of specimens examined. — 7.

Hyperaspis lanei Hatch

Hyperaspis lanei Hatch, 1962:159. Type locality: "Bead Lake, Washington." Type in WUSP.

Comparison. — Distinguished from other North American *Hyperaspis* species by combination of characters: general habitus and maculation (Fig. 26); size (TL 2.0-2.5 mm); geographic range confined to western North America (Fig. 117).

Description. — Habitus and maculation as in Fig. 26. Body elongate oval, oblong. Color: head black, except antennae and mouthparts; sexually dimorphic; pronotum and elytra mostly black, bordered with lateral yellow margins in both sexes; elytra maculate with abbreviated, relatively narrow marginal vitta for basal 0.66 - 0.80; wider posteriorly; apical spot small, transversely oval; ventral surface and legs black, except tibiae brown, tarsi and epipleura orange-brown. Vestiture: normal for genus. Sculpture: head finely punctate, shagreened; pronotum and elytra more distinctly punctate, without isodiametric meshes between punctures, shiny; punctures of elytra more irregular, unevenly spaced. TL 2.0 - 2.5 mm; W 1.7 mm.

Variation. — Color: sexually dimorphic - female with head black, male with head yellow, black at vertex.

Distribution. — Western North America, Fig. 117. Recorded from: southern British Columbia, Idaho, and Washington.

Collecting and natural history notes. — Habitat: xeric savanna, sagebrush communities.

Number of specimens examined. — 10.

Hyperaspis dissoluta Crotch

Hyperaspis dissoluta Crotch, 1873:379. Type locality: none given.

Hyperaspis coloradana Casey, 1908:417. Type locality: Boulder, Colorado. Type in USNM. Synonymized by Dobzhansky, 1941:59.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 15); size (TL 2.2-3.0 mm); geographic range confined to western North America (Fig. 118); and details of male genital armature (figured by Dobzhansky, 1941).

Description. — Habitus and maculation as in Fig. 15. Body oval, convex. Color: head black, frons orange-yellow; eyes with greenish-blue lustre; antennae and mouthparts light brownish-yellow; pronotum mostly black, anterior angles and margin narrowly yellow; elytra mostly black, maculation orange-yellow; each elytron with marginal vitta for basal 0.66; subapical spot elongate oval; ventral surface black; front legs, tibiae and tarsi of middle and hind legs orange-yellow. Sculpture: dorsal surface distinctly punctate, polished; lateral margins of elytra narrowly reflexed. Abdomen: metacoxal arcs complete, subparallel with sternal margin. TL 2.2 - 3.0 mm; W 1.6 - 2.2 mm.

Distribution. — Western North America, Fig. 118. Recorded from: Arizona, British Columbia, California, Colorado, Idaho, Montana, Nevada, Oregon, Texas, and Washington.

Collecting and natural history notes. — Collected in southern British Columbia only.

Number of specimens examined. — 14.

Hyperaspis simulatrix Dobzhansky

Hyperaspis simulatrix Dobzhansky, 1941:72. Type locality: "Oakley, Idaho." Type in USNM (54216).

Comparison. — Specimens of this species resemble those of *H. lugubris* (Randall), which are on average larger, and *H. quadrioculata* (Motschulsky), a Californian species.

Description. — Habitus and maculation as in Fig. 27. Body elongate oval, convex. Color: head black, frons orange-yellow, vertex black; pronotum mostly black, lateral margins orange-yellow; elytra mostly black, maculate with orange-yellow spots; each elytron with elongate oval discal spot, and transverse subapical spot, lateral margin with orange-yellow vitta for basal 0.60; ventral surface and legs brown-black, except femora and tarsi light brownish-yellow; Abdomen: metacoxal arcs complete. Legs: tarsal claws appendiculate. TL 2.2 - 2.5 mm; W 1.6 - 1.8 mm.

Variation. — Color: head black in females.

Distribution. — Western North America, Fig. 116. Recorded from: southern Alberta, southern British Columbia, Idaho, Montana, Oregon, Saskatchewan, Utah, and Washington.

Collecting and natural history notes. — Habitat: collected from *Artemisia* plants during June-July in southern Alberta.

Number of specimens examined. — 8.

Hyperaspis lugubris (Randall)

Coccinella lugubris Randall, 1838:52. Type locality: "Massachusetts." Type not studied.

Hyperaspis venustula Mulsant, 1850:671. Type locality: "l' Amerique boreale." Type not studied. Synonymized by Dobzhansky, 1941:21.

Hyperaspis jucunda LeConte, 1852:134. Type locality: "Illinois." Type not studied.

Hyperaspis lecontei Crotch, 1874:233. Unnecessary replacement name for *H. jucunda* LeConte, 1852.

Hyperaspis separata Casey, 1924:165. Type locality: "Natick, Massachusetts." Type in USNM. Synonymized by Dobzhansky, 1941:21.

Comparison. — Distinguished from other North American *Hyperaspis* species by: general habitus and maculation (Fig. 29); size (TL 2.3-3.3 mm); transcontinental range in southern half of North America (Fig. 119); details of male genital armature (figured by Dobzhansky, 1941).

Description. — Habitus and maculation as in Fig. 30. Body elongate oval, convex. Color: head orange-yellow; pronotum: orange yellow in males, black with orange-yellow lateral margins in females; elytra mostly black, maculate with orange-yellow spots and vittae; each elytron with median, elongate oval orange-yellow spot; round apical spot; marginal vitta for 0.66 of length, expanded posteriorly; mouthparts and legs rufous. Male genitalia (figured by Dobzhansky, 1941). TL 2.3 - 3.3 mm; W 1.6 - 2.4 mm.

Variation. — Coloration of pronotum varies to some extent in both males and females. Some males with posterior part and middle darker to brown. Females with anterior margin narrowly yellow.

Distribution. — Widely ranging in North America, Fig. 119. Recorded from: southern Alberta, southern British Columbia, California, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Massachusetts, Michigan, Montana, New Jersey, New York, North Dakota, southern Saskatchewan, South Dakota, Texas, and Wisconsin.

Collecting and natural history notes. — Habitat: grassland, savannas and parkland. In the study area collected in southern Alberta and British Columbia only.

Number of specimens examined. — 18.

Hyperaspis jasperensis, new species

Hyperaspis jasperensis, new species. Type locality: Canada, Alberta, Jasper National Park, Bald Hills (53° 43' N, 117° 41' W). Holotype: male, labelled "Holotype (red border, circular label); CANADA, Alberta, Jasper National Park, Bald Hills. P. Kuchar, collector." Deposited in CNC. Paratypes: 5 males, 4 females; labelled "Paratype" (yellow border, circular label), other data as for holotype. Deposited in UASM, USNM, CAS, FMNH, CUNY, and WSUP.

Derivation of specific epithet. — Named in reference to the type locality - Jasper National Park.

Comparison. — Distinguished from other North American *Hyperaspis* species by: immaculate, brown-black elytra and restricted range in Northern Rocky Mountains (Fig. 119).

Description. — Habitus and maculation as in Fig. 28. Superficially similar to *Hyperaspidius arcuatus*, (Fig. 16). Body elongate oval, oblong. Color: dorsal surface brown-black, except orange-brown lateral and anterior pronotal margin, and humeral angles of each elytron; mouthparts brown; antennae yellow; ventral surface brown-black, except tarsi yellowish-brown. Vestiture: normal for genus. Sculpture: dorsal surface distinctly punctate, punctures shallow, without isodiametric meshes; ventral surface distinctly punctate, punctures large. Head: normal for genus; labium (Fig. 191). Legs: normal, tarsal claws simple (Fig. 190). Male genital armature (Fig. 171A, 171B, 171C): Female genitalia (Fig. 171D): spermatheca retort-shaped. TL 1.5 mm; W 0.8 mm.

Note on relationships. — This species is a member of *H. annexa* group of Dobzhansky (1941). This is based on apomorphic structural characters shared by the members of this group, e.g., structure of male genital armature, (shape of median lobe).

Distribution. — Alpine zone of the Northern Rocky Mountains. Recorded from the type locality only.

Collecting and natural history notes. — Habitat: alpine tundra, i.e. barren ridge of shale (7,600 ft; 2,316 m); windswept *Dryas* tundra (7,400 ft; 2,255 m); and also east facing slope with diverse vegetation, notably *Anemone occidentalis*, *Artemisia norvegica*, grasses and sedges (7,300 ft; 2,225 m); Peter Kuchar (*in litteris*).

Genus *Brachiacantha* Dejean

Brachiacantha Dejean, 1836:458. Type-species: *Coccinella dentipes* Fabricius, 1801:381. Subsequently designated by Crotch, 1874:210.

Brachyacantha Chevrolat, 1842:705. Unjustified emendation.

Derivation of name. — From Greek, *brachys* + *akantha* = short + thorn, in reference to spinose front tibiae. First used by Dejean (1836), who credited its origin to Chevrolat. Subsequent authors used Chevrolat's (1842) spelling.

Comparison. — Distinguished from other North American genera of Hyperaspini by: modified front tibiae, spinose at anterior edge (Fig. 176); tarsal claws appendiculate (Fig. 183, 184); eyes narrowly emarginate by post-antennal process.

Description. — Habitus and maculation as in Fig. 31. Body elongate oval, compact and prominently convex. Head: antennae each of 11 articles, terminal articles modified as in other Hyperaspini (Fig. 175, 177, 178); ultimate article of maxillary palpus securiform; eyes emarginate by postantennal process. Legs: relatively short and stout, retractile; tarsal formula 4-4-4, claws each with large basal plate, (Fig. 183, 184); front tibiae spinose anteriorly at basal 0.40; anterior edge grooved (Fig. 176). Abdomen. Six visible sterna in female, apparently seven in male (7th = tergum). Males only - 3rd, to 5th sterna modified; depressed at middle or variously bicuspid. TL 1.6 - 6.0 mm; W 1.2 - 4.0 mm.

Variation. — The sexes distinguished by presence of seven apparent sterna (7th = tergum) in males, their modification in the last three; and in many species yellow-orange head in males as compared to black in females. The shape of front tibia, position of spine and other modifications thereof provide characters for identification of species. Color and pattern: elytral maculation polymorphic, varied in extent and melanism.

Distribution. — Panamerican genus with centre of diversity in Mexico and Central America. Ten species have been reported from South America, 19 from Mexico and Central America, and 18 from North America north of Mexico (Leng, 1911). Only one species was recorded from the study area.

Natural history. — Larvae are inquilines in ant nests (*Lasius* sp.), and feed upon aphids and coccids carried by ants into their nests (Wheeler, 1911).

Systematic studies. — Casey (1899, 1908); and Leng (1903, 1911).

Brachiacantha ursina (Fabricius)

Coccinella ursina Fabricius, 1787:61. Type locality: "America boreali." Type not studied.

Coccinella albifrons Say, 1824:94. Type locality: "Missouri." Type lost. Synonymized by Wingo (1952:27).

Brachycantha stellata Casey, 1899:117. Type locality: "Indiana." Type in USNM. NEW SYNONYMY.

Brachyacantha congruens Casey, 1899:117. Type locality: "Asheville, North Carolina." Type in USNM. NEW SYNONYMY.

Brachyacantha uteella Casey, 1908:413. Type locality: "Milford, Utah." Type in USNM. NEW SYNONYMY.

Brachyacantha sonorana Casey, 1908:413. Type locality: "Colonia Garcia, Chihuahua; Mexico." Type in USNM. NEW SYNONYMY.

Note on synonymy. — Based on examination of type specimens in Casey's collection (USNM), I consider these to be conspecific with one another, and with the species described by Fabricius, *B. ursina*. This conclusion is based on presence of intermediate variants (melanic morphs) in this polymorphic species, and the same structure of male genital armature among different morphs.

Comparison. — This is the only species of *Brachiacantha* recorded from the study area. Distinguished from *B. dentipes* by smaller size and modification of front tibia (Fig. 176).

Description. — Habitus and maculation as in Fig. 31. Body elongate oval, compact, prominently convex. Color: head yellow-orange; vertex black; eyes with bluish-green lustre; antennae and mouthparts orange-yellow; pronotum mostly black, except anterior angles and margin maculate yellow-orange; elytra yellow-orange; suture narrowly black, stripe expanded posteriorly; each elytron with humeral and subapical black spot; confluent with each other and sutural stripe depending on degree of melanism; ventral surface and legs brown-black, except femora and tarsi light brownish-yellow. Legs: front femora modified, with anterior edge produced into sharp blade, toothed at proximal end; tarsal formula 4-4-4, claws appendiculate. Abdomen: metacoxal arcs complete. TL 2.0 - 3.6 mm; W 2.0 - 2.5 mm.

Variation. — Polymorphic species. In melanic specimens, pronotum mostly black, except yellow-orange anterior angles; elytra black, each with five small, orange yellow spots (Fig. 31). Black pigmented spots are confluent or missing entirely in some specimens. Degree of melanism could be clinal, but even the relatively small sample available for study indicates that the melanic variants are predominant in most northern localities, except the southern, xeric portion of Alberta.

Distribution. — Widely ranging in North America, and Mexico, Fig. 120. Recorded from: Alabama, Alberta, Arizona, British Columbia, Colorado, Florida, Illinois, Indiana, Kansas, Louisiana, southern Manitoba, Michigan, Montana, Mexico, New Mexico, Ontario, Oregon, Pennsylvania, Quebec, Saskatchewan, South Carolina, South Dakota, Utah, Washington, Wisconsin, and Wyoming.

Collecting and natural history notes. — Habitat: Larvae are inquiline in nests of ants, *Lasius claviger* (Roger), preying upon *Pemphigus* species domesticated by the ants (Schwarz, 1890). Adults develop in ant nests before dispersal.

Number of specimens examined. — 142.

Genus *Chilocorus* Leach

Chilocorus Leach, 1815:116. Type-species: *Coccinella cacti* Linnaeus, 1767:458. Subsequently designated by Hope, 1840: 157.

Chilochorus Hope, 1840:157. Misspelling.

Derivation of name. — *Chilocorus*, from Greek, *cheilos* + *koros* = lip (labrum) + wide (expanded); in reference to laterally expanded clypeus.

Comparison. — Distinguished from other Chilcorini recorded from the study area by: antenna of eight articles; setose anterior angles of pronotum and beaded ridge extended from posterior angles along basal margin.

Description. — Chilcorini with body broadly oval, prominently convex. Head: antennae of 8 articles each. Elytra: margins explanate but not reflexed, narrowly beaded, epipleura shallowly foveate. Legs: tibiae modified, spinose at basal 0.33; tibial spurs absent; tarsal formula 4-4-4, claws with quadrate basal tooth. Abdomen: metacoxal arcs incomplete.

Distribution. — World wide, genus with more than 50 species included. In North America represented by six described species.

Natural history. — Both larvae and adults are predaceous on Aphidae, Chermidae, and other homopterous insects.

Systematic studies. — The North American species of this genus have been studied by Casey (1899), Leng (1903), Smith (1959, 1962, 1966). Chapin (1965) revised the tribe Chilcorini at generic level for the world.

Key to adults of the species of *Chilocorus* from western Canada and Alaska

The following three species are separable only on basis of geographic distribution ranges and chromosome numbers, (adopted and modified from Smith, 1959).

- 1 (0) Karyotype 2n=14 (southern Alberta and Saskatchewan). *C. hexacyclus* Smith, p. 319
- 1' Karyotype 2n=19+ 2
- 2 (1') Karyotype 2n=20 (interior British Columbia) *C. tricyclus* Smith, p. 319
- 2' Karyotype 2n=22+s (widely ranging) *C. stigma* (Say), p. 319

Chilocorus stigma (Say)

Coccinella stigma Say, 1835:202. Type locality: None specified. "United States." Type lost.

Chilocorus bivulnerus Mulsant, 1850:460. Type locality: "l'Amérique du Nord." Type not studied. Synonymized by Casey, 1899.

Comparison. — Karyotype: $2n=22+s$. Polymorphic: males, $2n=19-25$; females, $2n=20-26$.

Description. — Habitus and maculation as in Fig. 33. Body short oval, prominently convex to subhemispherical. Color: head black; mouthparts brown-black, antennae light brownish-yellow; pronotum and elytra mostly black, except maculation orange-yellow; each elytron with circular, discal spot. Sculpture: dorsal surface distinctly punctate, polished; elytral punctures relatively large, unequal. Abdomen: metacoxal arcs incomplete, subparallel with sternal margin. TL 4.4 - 5.0 mm; W 4.3 mm.

Distribution. — Restricted to east of Rocky Mountains and Sierra Nevada Mountains, (Fig. 124). Recorded from: Alabama, Alberta, Arizona, Arkansas, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Manitoba, Michigan, Mississippi, Missouri, Montana, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Ohio, Ontario, Pennsylvania, Quebec, Saskatchewan, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, Wisconsin, and Wyoming.

Collecting and natural history notes. — Habitat: parkland and forest, apparently associated with *Adelges* (*Chermes*) species, and conifers.

Number of specimens examined. — 132.

Chilocorus tricyclus Smith

Chilocorus tricyclus Smith, 1959:446. Type locality: "Grand Forks, British Columbia." Type in CNC.

Comparison. — Distinguished from other *Chilocorus* species cytologically. Karyotype: $2n=20$. Meiotic formula - 3 ring II + 6 non-ring II; II + 1 neo-XY (male): XX (female) II.

Description. — Superficially indistinguishable from *C. stigma* and *C. hexacyclus*. TL 4.4 - 5.0 mm; W 4.3 mm.

Distribution. — Northwestern North America, Fig. 122. Recorded from: West of Continental Divide in British Columbia and Washington.

Collecting and natural history notes. — Habitat: trees and shrubs in coniferous parkland and forests. Food: specimens of *Phenacaspis pinifoliae* (Fitch).

Number of specimens examined. — 21.

Chilocorus hexacyclus Smith

Chilocorus hexacyclus Smith, 1959:446. Type locality: "Conquest, Saskatchewan." Type in CNC.

Comparison. — Distinguished from other North American *Chilocorus* species only on the basis of chromosomal count. Karyotype: $2n=14$. Meiotic formula - 6 ring II + 1; neo-XY (male): XX (female) II.

Description. — Superficially indistinguishable from the two previous species *C. stigma* and *C. tricyclus*. Karyotype: two arms of each of 12 autosomes and X euchromatic, Y metacentric; not acrocentric and euchromatic as in *C. tricyclus* (Smith, 1962). TL 4.4 - 5.0 mm; W 4.3 mm.

Distribution. — Northern North America, Fig. 123. Recorded from: southern Alberta and Saskatchewan only.

Number of specimens examined. — 11.

Genus *Exochomus* Redtenbacher

Exochomus Redtenbacher, 1843:11. Type-species: *Coccinella quadripustulata* Linnaeus, 1758:367. Subsequently designated by Korschefsky, 1932:252. Designations of *Coccinella tripustulata* DeGeer, 1775:365; by Crotch (1873:376), and *Coccinella nigromaculata* Goeze, 1778:284; by Crotch (1874:192) are both invalid because these names were not among those originally included.

Derivation of name. — *Exochomus*, from Greek *exochos* and *omos* = standing out (prominent), and shoulder in reference to prominent humeral angles of elytra.

Comparison. — Distinguished from other North American Chilacorini by: antennae each of 10 articles, tarsal claws each with subquadrate basal tooth.

Description. — Chilacorini with body outline short oval to circular, moderately convex. Head: antennae each of 10 articles; mandibles simple at apex; terminal article of maxillary palpus subsecuriform; ultimate article of labial palpus cylindrical, twice as long as wide. Thorax: pronotum narrowly margined across base, lateral margins slightly reflexed; prosternal lobe narrow, truncate at apex, anterior coxae almost contiguous; legs with moderately stout femora, tibiae slender, tarsal formula 4-4-4, claws with subquadrate basal tooth each. Elytra: margin distinctly beaded, epimera not foveate. Abdomen: metacoxal arcs complete or virtually so. Male genitalia (figured by Chapin, 1965a): basal lobe slender, parallel in basal 0.66, slightly asymmetrical in apical 0.33; lateral lobes .12 longer than basal lobe; siphon arcuate slender, or even diameter throughout most of its length, apex twisted, siphonal capsule well developed.

Distribution. — World wide, genus with six species included (Chapin, 1965a).

Exochomus aethiops (Bland)

Coccinella aethiops Bland, 1864:72. Type locality: "Colorado." Type not studied.

Brumus aethiops: Korschefsky, 1931:265. Misidentification.

Exochomus mormonicus Casey, 1908:411. Type locality: "Marysville, Utah." Type in USNM (35556). Synonymized by Gordon, 1974a:2.

Comparison. — Distinguished from other North American Chilacorini by combination of characters: tarsal claws appendiculate; antennae of 10 articles each. Specimens of *E. aethiops* (Bland) are the only Chilacorini known in the study area with the entire dorsal surface immaculate, black.

Description. — Body oval, prominently convex. Color: head black; pronotum mostly black, anterior margins faintly rufescent; elytra black, immaculate, except margins in some specimens brownish-black. Sculpture: microsculpture of pronotum and elytra finer than in other Chilacorini, punctures shallow and indistinct. TL 2.9 - 4.0 mm; W 2.4 - 3.5 mm.

Distribution. — Western North America, Fig. 121. Recorded from: southern Alberta, Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, Mexico, western Oregon, southern Saskatchewan, Utah, Washington, and Wyoming.

Number of specimens examined. — 16.

Genus *Brumoides* Chapin

Brumoides Chapin, 1965a:237. Type-species: *Coccinella suturalis* Fabricius, 1798:78. Designated by Chapin, 1965a:237; original designation.

Comparison. — Distinguished from other Chilacorini recorded from the study area by: simple tarsal claws, and antennae each of 8 articles.

Description. — Chilacorini with body oval, moderately convex, upper surface glabrous. Head: antennae each of 8 articles; maxillary palpus with terminal article securiform; labial palpus slender, terminal article cylindrical; Elytra: margins distinctly explanate and reflexed. Legs: middle and hind tibiae each with prominent spurs; tarsal formula 4-4-4, claws simple. Abdomen: metacoxal arcs complete. Male genitalia (figured by Chapin, 1965a): basal lobe triangular; lateral lobes approximately twice longer than basal lobe.

Distribution. — World-wide, genus with nine species included (Chapin, 1965a). In North America represented by two described species.

Natural history. — Both larvae and adults predaceous on *Adelges piceae* Ratz., and seem to be associated with conifers.

Brumoides septentrionis (Weise)

Brumus septentrionis Weise, 1885:230. Type locality: "Hudson's Bay." Type not studied.

Exochomus ovoideus Casey, 1899:107. Type locality: "Indiana." Type in USNM. Synonymized by Gordon (1974a).

Exochomus parvicollis Casey, 1908:411. Type locality: "St. George, Utah." Type in USNM. Synonymized by Gordon (1974a).

Comparison. — Some melanic specimens of this polymorphic species closely resemble those of *Exochomus californicus* Casey, from which these can be separated by simple tarsal claws (appendiculate in *Exochomus*).

Description. — Habitus and maculation as in Fig. 34. Body broadly oval, prominently convex. Color: head black; pronotum mostly black; elytra orange-yellow, maculate with black spots, elytral margin narrowly pigmented black; each elytron with two spots, and sutural band expanded at apices; ventral surface and legs brown to black. Abdomen: metacoxal arcs complete. Tarsal claws simple. TL 3.5 - 4.5 mm; W 2.0 - 2.7 mm.

Variation. — Color and maculation: size of black spots on elytra varied: from indistinct to large and confluent; sutural band from narrow to wide and confluent with spots. In most extreme case of melanism, spots confluent to cover the elytra almost entirely, except for humeral margin and subapical spot on each elytron.

Distribution. — Widely ranging in North America, Fig. 125. Recorded from: Alabama, Alberta, Arizona, Arkansas, British Columbia, California, Colorado, Idaho, Illinois, Indiana, Manitoba, Montana, Nevada, New Mexico, New Jersey, New York, Oregon, Pennsylvania, Saskatchewan, Texas, Utah, Washington, and Wyoming.

Number of specimens examined. — 175.

Genus *Coccidula* Kugelann

Coccidula Kugelann, 1798:421. Type-species: *Chrysomela scutellata* Herbst, 1783:58. Subsequently designated by Crotch, 1874:300. The designation of *Dermestes rufus* Herbst, 1783:22; by Korschefsky, 1931:81 is invalid.

Strongylus Panzer, 1813:114. Preoccupied.

Cacidula Curtis, 1826. Misspelling.

Cacicula Stephens, 1828:319. Misspelling.

Derivation of name. — *Coccidula* - a coccid eater; in reference to feeding habits.

Comparison. — Eye facets much larger than in other groups of North American coccinellids; front coxal cavities open posteriorly.

Description. — Distinguished from other North American Coccinellidae by: Coccidulini of medium size (3.0 mm). Body elongate, oblong. Color: head black, pronotum and elytra orange yellow, maculation black. antennae and mouthparts orange-yellow; ventral surface - basisternum black (in some specimens also sternum III blackish); legs orange-yellow. Vestiture: dorsal surface pubescent, ventral surface and legs setose. Sculpture: head and pronotum distinctly punctate, shiny; elytra coarsely punctate, punctures large, unequal and coalescent. Head: eyes relatively small, coarsely faceted; antennae of 11 articles each, moderately long, clavate; mandibles bifid at apex; maxillary palpus of 3 articles each, ultimate article conical. Thorax: lateral margin of pronotum narrowly reflexed. Elytra: margins narrowly reflexed; epipleura not foveate. Legs: tarsal formula 4-4-4; claws appendiculate. Abdomen: metacoxal arcs complete, semicircular.

Distribution. — Holarctic Region, genus with five included species. Two species recorded from North America, and one from Mexico.

Coccidula occidentalis Horn

Coccidula occidentalis Horn; 1895:114. Type locality: None specified. - "Wyoming to Vancouver." Here restricted to British Columbia.

Coccidula lepida var. *suturalis* Weise, 1895:132. Type locality: "Ohio." NEW SYNONYMY.

Note on nomenclature. — Both names, *C. occidentalis* Horn and *C. suturalis* Weise, were published in the same year (1895). This led some authors to place *C. occidentalis* Horn as a synonym of *C. suturalis* Weise. But since *C. suturalis* was proposed only as a subspecific epithet for a varietal form of *C. lepida* LeConte, and *C. occidentalis* was fully described and illustrated as a new species, I use Horn's name for this species.

Comparison. — Distinguished from *C. lepida* by: elytral maculation (discal spot on elytra joined with scutellar spot), and range in western North America (Fig. 126).

Description. — Habitus and maculation as in Fig. 35. Oblong, subdepressed, finely pubescent. Color: dorsum yellowish red, except head and elytral maculation; ventral surface black, except last three sterna yellow; legs yellow. Sculpture: head sparsely punctate; pronotum more closely punctate; elytra much more coarsely punctate. TL 3.0 - 3.5 mm; W 1.4 mm.

Distribution. — Widely ranging in northern North America, Fig. 126. Recorded from: Alaska, Alberta, British Columbia, Colorado, Idaho, Illinois, Minnesota, Montana, Northwest

Territories, Ohio, Saskatchewan, Wisconsin, and Yukon.

Collecting and natural history notes. — Habitat: A number of specimens were obtained by sifting through forest litter and from pitfall traps.

Number of specimens examined. — 57.

Genus *Anatis* Mulsant

Anatis Mulsant, 1846:133. Type-species: *Coccinella ocellata* Linnaeus, 1758:366. Original fixation by Mulsant, through monotypy.

Myzia LeConte, 1852:130, 132. (In part).

Derivation of name. — From Greek, *anatos* = harmless, in reference to feeding habits (beneficial, aphidophagous).

Comparison. — Distinguished from other North American Coccinellini by: large size (TL 6.0-10.8 mm); body broadly oval in outline, markedly convex; tarsal claws each with large basal plate.

Description. — Habitus and maculation as in Fig. 36, 37, 38. Body short oval, markedly convex to subhemispherical. Color: head black with two interocular yellowish-white spots; antennae and mouthparts fulvous; pronotum mostly black, except for white discal mark, varied from species to species; elytra from ivory-white to deep mahogany brown, maculate with series of black dots, or only margin narrowly black, each elytron with humeral and scutellar spot, and two rows of three to four spots; ventral surface and legs brown-black, except in *A. mali* with sterna laterally and tibiae orange-brown. Vestiture: dorsal surface glabrous, except setose head and apex of elytra; ventral surface and legs setose. Sculpture: head distinctly punctate, shagreened; pronotum finely punctate, shagreened; elytra punctate, punctuation varied. Head: quadrate in dorsal aspect, bisinuate posteriorly; eyes prominent. Elytra: broadly rounded in outline to almost angulate in middle; margins narrowly explanate. Legs: normal for Coccinellini, tarsal claws with large basal tooth. Male genitalia (Fig. 172A, 172B, 172C): siphon elongate, arcuate tube; siphonal capsule well developed; lateral lobes shorter or equal in length with basal lobe, setigerous distally; basal lobe constricted to blunt point at apex; trapes paddle shaped. Female genitalia (Fig. 172D): spermatheca slender, semicircular cylinder; infundibulum well developed.

Distribution. — Members of this genus are known from throughout the Holarctic region. In North America, the geographic range extends southward to northernmost Mexico. *A. mali* (Say) reaches Cuba.

Systematic studies. — The North American species of this genus have been studied by: LeConte (1852); Casey (1899); McKenzie (1936); Timberlake (1943); Watson (1956).

Key to adults of the species of *Anatis* from western Canada and Alaska

- 1 (0) Pronotum mostly black, anterior margin pigmented black. Elytra deep mahogany brown, immaculate except lateral margins narrowly bordered black. Western North America, Rocky Mountains *A. lecontei* Casey, p. 323
- 1' Pronotum mostly black, maculate with M-shaped yellowish-white mark, anterior margin not pigmented black, narrowly yellowish-white. Elytra maculate with black spots 2
- 2 (1') Lateral margin of elytra bordered black, distinctly angulate at 0.66 in dorsal aspect. Western North America, Pacific seaboard, Columbia Plateau, parts of Rocky Mountains *A. rathvoni* (LeConte), p. 323
- 2' Elytra not distinctly angulate laterally, margin not bordered by narrow black stripe, reduced to single spot. 3
- 3 (2') Elytra maculate with black spots. Spots on each elytron ocellate (encircled by yellowish-white ring). Ventral surface and legs uniformly dark brown. Widely ranging in northern half of North America *A. borealis*, n. sp., p. 323
- 3' Elytra ivory-yellow, maculate with black spots. Spots not ocellate. Tibiae and tarsi yellowish-orange, femora dark brown. Eastern half of North America,

Atlantic seaboard, and Cuba *A. mali* (Say),

Anatis lecontei Casey

Anatis lecontei Casey, 1899:98. Type locality: New Mexico, Fort Wingate. Type in USNM.

Anatis rathvoni lecontei: Leng, 1903:208.

Comparison. — Distinguished from other North American *Anatis* species by immaculate elytra, except lateral margin narrowly bordered black.

Description. — Habitus and maculation as in Fig. 37. Body ovoid, prominently convex to hemispherical. Color: head black, frons with two white interocular spots; mouthparts brown to black, antennae light brownish-yellow; pronotum mostly black, maculate with two yellow-white stripes, convergent anteriorly (Fig. 37), and two, yellow-white spots at base; elytra dark mahogany brown, margins narrowly bordered black; ventral surface and legs black. TL 6.0 - 10.2 mm; W 7.5 - 8.7 mm.

Variation. — The white, basal spots on pronotum vary in size, in some specimens greatly reduced or missing. Johnson (1910:74) noted variability of the two pronotal white spots, and the width of the lateral stripe.

Distribution. — Western North America, Fig. 127. Recorded from: southern Alberta, southern British Columbia, California, Colorado, Idaho, New Mexico, Oregon, Utah, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: parkland, savannas and coniferous forests.

Number of specimens examined. — 126.

Anatis rathvoni (LeConte)

Myzia rathvoni LeConte, 1852:132. Type locality: "Sacramento, California." Type in MCZ.

Anatis rathvoni: Malkin, 1943:198. Misspelling.

Comparison. — Specimens of this species are distinguished from other North American *Anatis* species by: markedly angulate lateral margin of elytra (Fig. 38); margin pigmented narrowly black, thickened at point of angulation; elytra maculate with black spots (Fig. 38); geographic range confined to western, coastal North America, Columbia Plateau, and parts of the Rocky Mountains (Fig. 129).

Description. — Habitus and maculation as in Fig. 38. Body ovoid, prominently convex to subhemispherical. Color: head black, with two interocular white spots; pronotum mostly black, dark area M-shaped; elytra brown-beige, lateral margin narrowly bordered black; maculate with black spots, in some specimens ocellate; each elytron with 6 spots, arranged in two rows (Fig. 38). TL 5.5 - 10.5 mm; W 5.0 - 7.0 mm.

Variation. — Johnson (1910:74) noted that elytral maculation is in some specimens very indistinctive, or spots absent. On the other hand, some specimens show faintly ocellate and very prominent elytral spots. Hatch (1962) reported variation in less than 3% of 122 specimens examined.

Distribution. — West of the Rocky Mountains, Fig. 129. Recorded from: southern Alberta, southern British Columbia, California, Idaho, Oregon, and Washington.

Collecting and natural history notes. — Habitat: on coniferous trees and shrubs, infested with *Adelges* (*Chermes*) specimens. The only Alberta specimen is from the shore of Waterton Lake (washup). It is, most probably, a wind-blown stray. British Columbia localities are numerous but restricted to the southern portion of the province. Specimens have been collected from sea level to 2743 m (9,000 ft), on Mt. Eddy in California.

Number of specimens examined. — 131.

Anatis borealis, new species

Anatis ocellata: of North American authors. Not Linnaeus, 1758:366.

Coccinella mali "var. a" Say, 1824:93. Informal designation. Type locality not given. Type lost.

Coccinella labiculata "var. a" Say, 1835:192. Informal designation. Type locality not given. Type lost.

Anatis 15-punctata: Provancher, 1877:696. Misidentification. Not DeGeer, 1775:376.

Anatis borealis, new species. Type locality: Edmonton, Alberta. Holotype: male, labelled - "Holotype (red border, circular label). CAN. Alberta, Edmonton. 25.VII.1971. J. Belicek, coll." Deposited in CNC. Paratypes: six males, labelled - Paratype (yellow border, circular label). "CAN. Alberta, Edmonton, 25.VII.1971." Deposited in USNM, CAS, FMNH, CUNY, UASM.

Note on nomenclature. — LeConte (1883:232, 192) indicated that both Says' descriptions were based on specimens of *A. mali*, a species restricted to the southeastern half of North America. Specimens of *A. borealis* which were in both instances involved, were informally designated as "var. a". Earlier, LeConte (1852:132) included species of the genus *Anatis* in the redefined genus *Myzia*, and regarded this species described by Say (1824, 1835) to be conspecific with *C. 15-punctata* DeGeer (= *A. ocellata* (Linnaeus)). Because Say's types are lost, and informal designation of specimens which might have served as types, no previous name is available for this species.

Derivation of specific epithet. — Named in reference to the geographic range of this species.

Comparison. — Distinguished from other North American *Anatis* species by: ocellate spots on elytra, concolorous femora and tibiae, and range in northern half of the North America (Fig. 128).

Description. — Habitus and maculation as in Fig. 36. Body ovoid, prominently convex. Color: head black, with two large, white, interocular spots; mouthparts brownish-black, antennae light brownish-yellow; pronotum mostly black, white maculation pattern as in Fig. 36; each elytron with 9 black, ocellate spots, arranged in three transverse rows (Fig. 36), apices maculate with small yellowish spots; ventral surface and legs light brown to dark brown, except femora darker at tibial joint. Male genital armature (Fig. 172A, 172B, 172C), median lobe slender arcuate tube, siphonal capsule well developed; basal lobe symmetrical, equal in length with lateral lobes. Female genitalia (Fig. 172D): spermatheca slender, arcuate cylinder. TL 6.0 - 9.0 mm; W 5.5 - 7.0 mm.

Note on relationships. — This species is most closely related to the Palaearctic, *A. ocellata*, based on the apomorphic characters (ocellate spots on elytra, concolorous legs) unique to members of these two species.

Distribution. — Northern half of North America, Fig. 128. Recorded from: Alaska, Alberta, British Columbia, Idaho, Illinois, Indiana, Kansas, Maine, Manitoba, Michigan, Minnesota, Montana, New York, North Dakota, Northwest Territories, Ontario, Oregon, Quebec, Saskatchewan, South Dakota, Washington, Wisconsin, and Yukon.

Collecting and natural history notes. — Habitat: parkland and forest. Hosts: *Chermes pinicorticis* Fitch, on *Pinus*; *Chaitophorus aceris* Linnaeus, on *Populus norvegica*; (Felt, 1906).

Number of specimens examined. — 148.

Genus *Myzia* LeConte

Mysia Mulsant, 1846:129. Not Lamarck, 1818.

Myzia Mulsant, 1846:227, (index). Type-species: *Coccinella oblongoguttata* Linnaeus, 1758:367. Fixed by Mulsant (1846:129), through monotypy.

Myzia LeConte, 1852:130. Validation of Mulsants' alternate spelling. If in original publication, a given name has been spelled in more than one way, the spelling adopted by the first reviser is to be accepted as correct (Article 32b, of the International Code of Zoological Nomenclature).

Neomysia Casey, 1899:98. Type-species: *Coccinella pullata* Say, 1826:301. Here designated. NEW SYNONYMY.

Paramysia Reitter, 1911:136. Unnecessary replacement name. Type species: *Coccinella oblongoguttata* Linnaeus, 1758:367, since Article 67(i) of the International Code of Zoological Nomenclature states that replacement names of the genus-group taxa must have the same type-species as the original one.

Note on synonymy. — *C. oblongoguttata* and *C. pullata* are congeneric taxa, based on similarities in size, color, and maculation, which separate members of this genus from other *Coccinellini*, and on structure of the male genitalia. Thus, *Neomysia* is a junior synonym of *Myzia*.

Note on nomenclature. — *Myzia* LeConte (1852) is a replacement name for *Mysia* Mulsant, which is a junior homonym of *Mysia* Lamarck, 1818 (Mollusca). Casey (1899) erected a new genus, *Neomysia*, said not to be congeneric with Mulsants' genus *Mysia*. In 1924, Casey changed his opinion and stated that his name *Neomysia* is a replacement name for preoccupied Mulsants' name. However, Reitter (1911) already proposed another name for Mulsant's taxon, being unaware of LeConte's action in 1852. Thus *Paramysia* Reitter, and *Neomysia* Casey are both junior synonyms of *Myzia* as validated by LeConte (1852).

Comparison. — Distinguished from other North American Coccinellini by combination of characters: large size (6.0-10.0 mm); elytral maculation (longitudinal vittae).

Description. — Coccinellini of large size (6.0 - 10.0 mm). Body ovoid, prominently convex to subhemispherical. Color: head brown-black, frons with interocular pale marks. Pronotum and elytra ochreous-yellow to beige, maculate with light brown to black spots and vittae; ventral surface brown to black, except legs in adults of some species light brown to orange-brown. Sculpture: dorsal surface finely punctate, polished, shiny. Head: eyes finely faceted, emarginate; antennae each of 11 articles, moderately long, clavate; mandibles bifid at apex; maxillary palpus of 3 articles, ultimate article securiform. Thorax: pronotum trapezoidal, lateral margins rounded, anterior margin recessed above eyes. Elytra: laberal margins narrowly explanate, epipleura not foveate. Legs: normal, tarsal formula 4-4-4, claws appendiculate, distinctly cleft. Abdomen: metacoxal arcs incomplete.

Distribution. — Holarctic Region. One species was described from the Palaearctic Region (*M. oblongoguttata* (Linnaeus)), three from North America, and one from Mexico.

Natural history. — Both adults and larvae are predaceous on aphids and chermids associated with conifers. They are also found on deciduous trees and shrubs infested with aphids.

Key to adults of the species of *Myzia* from western Canada and Alaska

- | | | | |
|---|-----|---|--|
| 1 | (0) | Pronotum with distinct black mark | 2 |
| | | Pronotum with obscure, light-brown mark | <i>M. horni</i> (Crotch), p. 326 |
| 2 | (1) | Lateral white margin of pronotum maculate with black spot | |
| | | | <i>M. pullata</i> (Say), p. 325 |
| | | Lateral white margin of pronotum without black spot | |
| | | | <i>M. subvittata</i> (Mulsant), p. 325 |

Myzia subvittata (Mulsant)

Myzia subvittata Mulsant, 1850:139. Type locality: "les parties occidentales de l'Amerique du Nord." Type not studied.
Neomysia oregona Casey, 1924:160. Type locality: "Bull Run, Clackamas Co., Oregon." Type in USNM.

Comparison. — Specimens of *M. subvittata* are more convex than similarly maculate, western specimens of *M. pullata*. Legs of adults of the latter species are brown-black as compared to rufo-light brown in *M. subvittata*. Pronotal black spot in white lateral stripe, characteristic of *M. pullata* east of the Rocky Mountains, is reduced or missing in some British Columbia specimens.

Description. — Habitus and maculation as in Fig. 39. Body ovoid, prominently convex, subhemispherical. Color: head yellow, vertex with black, triangular mark; mouthparts and antennae light brownish-yellow; pronotum cream-yellow, pronotal maculation distinct, brown-black trapezoidal mark, in some specimens divided medially; elytra cream-yellow, shiny; maculate with brown-black, three longitudinal vittae on each elytron (Fig. 39); lateral vitta narrow, median interrupted and joined laterally to sutural vitta, suture narrowly pigmented brown; ventral surface and legs reddish-light brown. TL 7.5 - 8.0 mm; W 5.0 - 5.8 mm.

Variation. — Color: elytral maculation in some western specimens indistinct (Oregon, California).

Distribution. — Western North America, Fig. 130. Recorded from: southern Alberta, southern British Columbia, California, Idaho, Oregon, Utah, and Washington.

Collecting and natural history notes. — Habitat: coastal chaparral communities, parkland. The two localities (Banff and Waterton) in Alberta from which specimens were seen are records probably of incidental strays.

Number of specimens examined. — 121.

Myzia pullata (Say)

Coccinella pullata Say, 1826:301. Type locality: None specified. "Eastern coast of Virginia, and Florida." Type lost.
Coccinella notans Randall, 1838a:49. Type locality: "Maine." Synonymized by Mulsant, 1850:1023.
Neomysia randalli Casey, 1899:99. Type locality: "Lake Superior." Type in USNM. NEW SYNONYMY.
Neomysia montana Casey, 1899:100. Type locality: "Colorado." Type in USNM. NEW SYNONYMY.

Note on synonymy. — Upon examination of type specimens in Casey's collection (USNM), I consider these to be color variants, and conspecific with *M. pullata*. This conclusion is based on: structure of the male genital armature among the different color variants in *M. pullata* complex; existence of intermediate color variants (maculation) among specimens from vicariant populations.

Comparison. — Specimens of this species can be distinguished from those of other species in this genus on basis of pronotal maculation. The median trapezoidal mark is extended laterally into the white margin of pronotum, in comma-like projection, which in some specimens may be reduced to a separate dot.

Description. — Habitus and maculation as in Fig. 41. Broadly oval, prominently convex. Color: frons with large, trapezoidal black mark between eyes, separating yellowish-white, interocular spots; labrum brown to black; pronotum with median trapezoidal mark, in some specimens medially divided; other maculation as given in comparison above; elytra from ochreous to brown, maculate or not, in maculate specimens, maculation varied, of 3 interrupted or variously confluent longitudinal vittae on each elytron; ventral surface and legs brown to black. TL 6.4 - 7.2 mm; W 4.9 - 5.5 mm.

Variation. — Maculation of pronotum and elytra varied in extent and intensity. Generally, more melanic specimens with brown-black vittae were recorded from northern regions or from higher elevations.

Distribution. — Widely ranging in North America east of Rocky Mountains and Sierra Nevada Mountains, Fig. 132. Recorded from: Alberta, Illinois, Indiana, Iowa, Kansas, Labrador, Manitoba, Michigan, Minnesota, Missouri, New Brunswick, New Jersey, New York, Ohio, Ontario, Pennsylvania, Quebec, Saskatchewan, Tennessee, Texas, Wisconsin, and Yukon.

Collecting and natural history notes. — Habitat: coniferous trees and shrubs, infested with aphids and scale insects (*Lecanium* species). Often, after sudden storms, a large number of specimens can be obtained from wash-up debris on shores of larger lakes.

Number of specimens examined. — 156.

Myzia horni (Crotch)

Mysia hornii Crotch, 1873:375. Type locality: "Oregon." Type not studied.

Neomysia interrupta Casey, 1899:99. Type locality: "Fort Wingate, New Mexico." Type in USNM. NEW SYNONYMY.

Comparison. — Specimens of this species are distinguished from those of other species in this genus by: indistinct pronotal maculation; elytral maculation - inner discal vitta extended posteriorly and joined to median vitta; distribution range in western North America (Fig. 131).

Description. — Habitus and maculation as in Fig. 40. Large sized Coccinellini; body ovoid, prominently convex, subhemispherical. Color: head yellow, pronotum ochreous-yellow, maculate with light brown, indistinct, M-shaped mark; elytra ochreous-yellow, maculate with light brown vittae; each elytron with three longitudinal vittae, convergent posteriorly, marginal two interrupted at basal 0.20, suture and margin narrowly pigmented brown; ventral surface and legs reddish-light brown. TL 6.7 - 8.0 mm; W 5.4 - 6.0 mm.

Variation. — Maculation variously distinct.

Distribution. — Western North America, Fig. 131. Recorded from: Alberta, Arizona, British Columbia, Idaho, Montana, Nebraska, New Mexico, Oregon, Texas, Washington.

Collecting and natural history notes. — Habitat: coniferous parkland and forest. Records from British Columbia are numerous, particularly from the southern portion of the province. The only Alberta record is from Medicine Hat, and this is most likely an imported specimen, or wind-blown stray.

Number of specimens examined. — 137.

Genus *Calvia* Mulsant

Calvia Mulsant, 1846:140. Type-species: *Coccinella decemguttata* Linnaeus, 1767:583. Subsequently designated by Crotch, 1874:143. The designation of *Coccinella quattuordecimguttata* Linnaeus, 1758:367; by Korschefsky (1932:520) is invalid.

Anisocalvia Crotch, 1873:364, 373. Type-species: *Coccinella quattuordecimguttata* Linnaeus, 1758:367. Subsequently designated by Crotch, 1874:143. NEW STATUS.

Comparison. — Distinguished from other North American Coccinellini by absence of isodiametric meshes between punctures on pronotum (Fig. 81).

Description. — Coccinellini of medium size (TL 4.0 - 6.0 mm). Body oval, prominently convex. Color: varied, maculation pattern as in Fig. 42a, 42b; polymorphic species. Head: eyes emarginate, finely faceted; antennae each of 11 articles, moderately long, clavate, scape enlarged; mandibles bifid at apex; maxillary palpus securiform. Thorax: pronotum recessed above eyes, slightly explanate laterally. Elytra: margins narrowly reflexed; epipleura not foveate. Abdomen: with 6 visible sterna. Metacoxal arcs incomplete. Tarsal claws appendiculate.

Distribution. — Holarctic region.

Natural history. — Both larvae and adults are predaceous on aphids, scale insects and other soft bodied insects.

Calvia quattuordecimguttata (Linnaeus)

Coccinella 14-guttata Linnaeus, 1758:367. Type locality: Lappland. Type in BMNH, not studied.

Coccinella duodecimmaculata Gebler, 1832:76. Type locality: "Siberia". Type not studied. Synonymized by Crotch, 1874:33.

Coccinella incarnata Kirby, 1837:231. Type locality: "60°N." Type not studied. Synonymized by Casey, 1899.

Coccinella cardisce Randall, 1838a:32. Type locality: "Maine." Type lost. Synonymized by Casey, 1899:96.

Coccinella obliqua Randall, 1838a:33. Type locality: "Maine." Type lost. Synonymized by Casey, 1899:96.

Coccinella similis Randall, 1838b:50. Type locality: "Massachusetts." Type lost. Synonymized by Casey, 1899:96.

Anisocalvia victoriana Casey, 1899:96. Type locality: British Columbia. Type in USNM. NEW SYNONYMY.

Anisocalvia elliptica Casey, 1899:97. Type locality: "Hudson Bay." Type in USNM. NEW SYNONYMY.

Agrabia sicardi Nunenmacher, 1912:448. Type locality: "Hornbrook, Siskiyou Co., California." Type in CAS. Synonymized by Gordon, 1974.

Anisocalvia lacustris Casey, 1924:158. Type locality: "Marquette, Michigan." Type in USNM. NEW SYNONYMY.

Anisocalvia bicordifera Casey, 1924:159. Type locality: "Lake George, New York." Type in USNM. NEW SYNONYMY.

Anisocalvia vancouveri Casey, 1924:159. Type locality: "British Columbia." Type in USNM. NEW SYNONYMY.

Anisocalvia quadrisignata Casey, 1924:159. Type locality: "Marquette, Lake Superior." Type in USNM. NEW SYNONYMY.

Anisocalvia postplagiata Casey, 1924:159. Type locality: "Marquette, Lake Superior." Type in USNM. NEW SYNONYMY.

Anisocalvia uniformis Casey, 1924:160. Type locality: "Adirondack Mts., New York." Type in USNM. NEW SYNONYMY.

Note on synonymy. — Upon examination of type specimens in Casey's collection (USNM), I consider these to be color, polymorphic variants of, and conspecific with *C. quattuordecimguttata*. This conclusion is based on: structure of male genitalia among the different morphs of this complex; field observations of actual mating of individuals with different color patterns, and from analyses of color and patterns in more than 1,000 individuals from many localities throughout the range of this species. These analyses confirmed the existence of intermediates between seemingly distinct color morphs, and also it was established that the difference in background color, and superimposed pattern results in an optical illusion which tends to amplify the discontinuity between various morphs.

Comparison. — Specimens of this species are distinguishable from all other North American Coccinellini by reduced microsculpture of pronotum (Fig. 81), which as viewed under light microscope (50x) appears as smooth, shiny surface without any obvious reticulation.

Description. — Habitus and maculation as in Fig. 42. Body broadly oval, prominently convex. Color: varied, polymorphic species; head black, mouthparts and antennae pale yellow; pronotum and elytra from yellow to black, or pinkish-red, maculate with black spots; pattern, Fig. 42a, 42b; ventral surface from yellow to brown. Vestiture: dorsal surface glabrous, except setose head; ventral surface and legs setose. Sculpture: head finely punctate; pronotum shiny, without isodiametric meshes between punctures (Fig. 81); elytra coarsely and distinctly punctate, punctures unequal. Thorax: pronotum with front and lateral margins beaded; elytral margin narrowly beaded. Legs: tarsal formula 4-4-4, claws appendiculate with prominent basal tooth. TL 4.0 - 5.5 mm; W 3.2 - 4.3 mm.

Variation. — Polymorphic species, color and maculation (Fig. 42a, 42b) varied from light brownish-yellow to black.

Distribution. — Holarctic Region, widely ranging in North America, Fig. 133. Recorded from: Alaska, Alberta, British Columbia, northern California, Connecticut (Britton, 1915), Idaho, Illinois, Labrador, Maine, Manitoba, Massachusetts, Michigan, Minnesota, Montana, Nova Scotia, Newfoundland, New Hampshire, New Jersey, New York, North Dakota, Northwest Territories, Ontario, Oregon, Pennsylvania, Quebec, Saskatchewan, Utah, Washington,

and Yukon.

Collecting and natural history notes. — Habitat: subarctic tundra, boreal forest, taiga, parkland. Arboricole on *Acer negundo*, *Betula occidentalis*, *B. papyrifera*, *Populus trichocarpa*, *Salix* spp., *Corylus* sp., *Larix laricina*, *Picea glauca*, *P. mariana*, *Abies lasiocarpa*. Occasionally found in fields on *Medicago sativa*, and other plants infested with aphids. Taken from specimen labels (22 individuals): "On hazel infested with aphids, mites, and *Lecanium* species. Creston, British Columbia."

Number of specimens examined. — 1650.

Genus *Adalia* Mulsant

Adalia Mulsant, 1850:49. Replacement name for *Idalia* Mulsant, 1846:44. Not Hübner, 1819. Type-species: *Coccinella bipunctata* Linnaeus, 1758:364. Subsequently designated by Crotch, 1874:99.

Derivation of name. — From Greek, *adales* = harmless; in reference to feeding habits (beneficial, aphidophagous).

Comparison. — Distinguished from other North American Coccinellini by: pronotum maculate with M-shaped dark mark which delimits two white spots inside this mark (Fig. 43). The white spots at the base of pronotum distinguish *Adalia* specimens from immaculate *Cycloneda* specimens (Fig. 45), with exception of melanic morphs (Fig. 43A), which are easily recognized by predominantly black pigmentation. Polymorphism in *Cycloneda* species is not known.

Description. — Coccinellini of medium size (TL 4.0 - 5.0 mm). Body oval, convex. Color: head black, frons with two yellowish-white, interocular spots; pronotum mostly black, maculation M-shaped, lateral margins whitish-yellow; elytra red-orange, maculate with black spots, polymorphic; ventral surface and legs black. Head: eyes relatively large, finely faceted, narrowly emarginate; antennae each of 11 articles, moderately long, clavate; mandibles bifid at apex; maxillary palpus of 3 articles each, ultimate article securiform. Thorax: pronotum trapezoidal, recessed above eyes. Sculpture: dorsal surface unequally punctate, shiny. Metacoxal arcs complete, semicircular. Legs: tarsal formula 4-4-4, claws appendiculate.

Distribution. — World wide, introduced to many areas, e.g., New Zealand, Australia.

Natural history. — Both larvae and adults are aphidophagous. Life history was described by Palmer (1914).

Adalia bipunctata (Linnaeus)

Coccinella bipunctata Linnaeus, 1758:364. Type locality: "Europa." Type in BMNH, not studied.

Coccinella frigida (Schneider), 1792:172. Type locality: ? northern Europe. Type not studied. Synonymized by Leng, 1903:195.

Coccinella bioculata Say, 1824:94. Type locality: "United States." Type lost. Synonymized by Crotch, 1874:102.

Coccinella humeralis Say, 1824:95. Type locality: "Arkansa." Type lost. Synonymized by Crotch, 1874:102.

Coccinella disjuncta Randall, 1838a:33. Type locality: "Maine." Type lost. Casey (1899:87) indicated the possibility of conspecificity with *C. frigida*. Synonymized by Leng, 1903:195.

Coccinella melanopleura LeConte, 1860:286. Type locality: "California." Type not studied.

Adalia ophthalmica Mulsant, 1850:56. Type locality: "l' Amerique du Nord." Type not studied. Synonymized by Leng, 1903:195.

Coccinella annectans Crotch, 1873:371. Type locality: "Colorado." Synonymized by Palmer, 1911:299.

Adalia ovipennis Casey, 1899:86. Type locality: "Sonoma Co., California." Type in USNM. Synonymized by Lusi, 1947a, 1961).

Adalia transversalis Casey, 1899:86. Type locality: "Las Vegas, New Mexico." Type in USNM. Synonymized by Lusi, 1947a, 1961).

Adalia ornatella Casey, 1899:86. Type locality: "Colorado." Type in USNM. Synonymized by Leng, 1903:195.

Adalia coloradensis Casey, 1908:401. Type locality: "Boulder Co., Colorado." Type in USNM. Synonymized by Palmer, 1911:299.

Comparison. — Distinguished from similar *Cycloneda* species by combination of characters: metacoxal arcs complete (incomplete in *Cycloneda*); maculation of pronotum (Fig. 43, 43a, 43b); details of male genital armature.

Description. — Habitus and maculation as in Fig. 43. Body short oval, prominently convex. Color: head black with two

whitish-yellow, interocular spots; mouthparts and antennae light brown; pronotum whitish-yellow, maculation elytra orange-yellow, maculate with black spots, polymorphic. Sculpture: dorsal surface distinctly punctate, polished; punctures of elytra large, unequal. Elytra: margins narrowly reflexed, beaded. Abdomen: metacoxal arcs complete. TL 4.0 - 5.0 mm; W 3.0 - 3.9 mm. Larval stages described by Gage (1920:41). and Emden (1949:275).

Variation. — Color and pattern: polymorphic species, for further details see Lusis (1932, 1947a, 1947b, 1961).

Distribution. — Holarctic Region. Introduced to Australia and New Zealand, in North America widely distributed (Fig. 134). Recorded from most Canadian provinces and from most states in the United States.

Collecting and natural history notes. — Habitat: parkland and forests.

Number of specimens examined. — 560.

Genus *Olla* Casey

Olla Casey, 1899:84, 93. Type-species: *Coccinella abdominalis* Say, 1824:95. Not Thunberg, 1794:viii. Subsequently designated by Korschefsky, 1932:288.

Comparison. — Distinguished from other North American Coccinellini by: general habitus and polymorphic maculation (Fig. 44); male genital armature with basal lobe bifurcate (Chapin, 1965: 220).

Description. — Body broadly oval, prominently convex. Head: antennae each of 11 articles moderately long; terminal article of maxillary palpus securiform, that of labial palpus cylindrical. Abdomen with six visible sterna. Metacoxal arc incomplete; Legs: tibial spurs present; tarsal formula 4-4-4, claws with quadrate basal tooth. Male genital armature with basal lobe symmetrical, bifurcate apically. Female genitalia: Infundibulum absent.

Distribution. — Panamerican genus, introduced to Guam. In North America represented by a single species.

Natural history. — Predaceous both as larvae and adults, aphidophagous. Life cycle described by Palmer, 1911.

Olla v-nigrum (Mulsant)

Coccinella abdominalis Say, 1824:95. Not Thunberg, 1794. Type locality: "Arkansa." Type lost.

Daulis v-nigrum Mulsant, 1866:64. Type locality: "United States. Synonymized by Timberlake, 1943:24.

Cycloneda sayi Crotch, 1871:6. Unnecessary replacement name for *C. abdominalis* Say, 1824. Preoccupied.

Olla plagiata Casey, 1899:94. Type locality: "None specified." Type in USNM. NEW SYNONYMY.

Olla sobrina Casey, 1899:94. Type locality: "Florida." Type in USNM. NEW SYNONYMY.

Olla minuta Casey, 1908:406. Type locality: "Texas (Brownsville)." Type in USNM. NEW SYNONYMY.

Olla fenestralis Casey, 1899:95. Type locality: "Las Vegas, New Mexico." Type in USNM. NEW SYNONYMY.

Olla abdominalis arizonae Casey, 1924:158. Type locality: "Arizona (near Tuscon)." Type in USNM. NEW SYNONYMY.

Note on synonymy. — Upon examination of type specimens in Casey's collection (USNM), I consider these to be polymorphic variants of and conspecific with *O. v-nigrum*. This conclusion is based on: structure of male genital armature among different color variants of this polymorphic species; existence of intermediates between seemingly distinct color morphs.

Comparison. — This is the only species of this genus known from the study area.

Description. — Habitus and maculation as in Fig. 44. Body broadly oval, markedly convex. Color: polymorphic species; melanic specimens mostly black dorsally, except yellow border of pronotum laterally, and orange-red, elongate spots in anterior half of each elytron; ventral surface and legs brown to black, except brown tarsi; non-melanic specimens mostly whitish-yellow dorsally, maculate with brown-black spots, pattern as in Fig. 44; ventral side and legs brownish-yellow, except metaepimera, metepisterna whitish-yellow. Vestiture: normal for genus. Sculpture: head, pronotum, and elytra finely, evenly punctate, shagreened. TL 4.2 - 4.9 mm; W 3.5 - 4.2 mm.

Variation. — Color and pigmentation: polymorphic species. *O. plagiata* was described based on mostly black, melanic specimens.

Distribution. — Widely ranging, transcontinental in North America, Mexico and Middle America, Fig. 135. Recorded from: Alabama, Arizona, Arkansas, southern British Columbia,

California, Colorado, Connecticut, District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, and West Virginia. Within the study area, recorded only from southern British Columbia (Summerland). McMullen (1975) pers. comm.

Number of specimens examined. — 65.

Genus *Cycloneda* Crotch

Cycloneda Crotch, 1871:6. New name for *Daulis* Mulsant, 1850:295. Not Erichson, 1842. Type-species: *Coccinella sanguinea* Linnaeus, 1763:11. Subsequently designated by Crotch, 1874:162.

Note. — Timberlake (1943:23) suggested that the genus *Cycloneda* is an arbitrary assemblage of species, and the proper use of this name should be restricted to *C. sanguinea* and related species (characteristically with immaculate elytra). Many species presently referred to *Cycloneda* will have to be transferred to *Neda*, and other taxa.

Comparison. — Distinguished from other North American Coccinellini by combination of characters: immaculate, orange-red elytra; incomplete metacoxal arcs; maculation of pronotum (Fig. 45).

Description. — Coccinellini of medium size (3.5 - 7.0 mm). Body short oval, prominently convex. Color: head black, except frons with two large interocular yellowish-white spots; pronotum mostly black, except narrowly white lateral margins; elytra orange-red to red, immaculate; ventral surface and legs black to light brownish-yellow. Head: eyes relatively large, finely faceted, emarginate; antennae each of 11 articles, moderately long, clavate; mandibles bifid at apex; maxillary palpus of 3 articles, ultimate article securiform; pronotum trapezoidal, recessed above eyes. Elytra: margins narrowly reflexed. Abdomen: metacoxal arcs incomplete, subparallel with sternal margin. Legs: tarsal formula 4-4-4; claws appendiculate.

Distribution. — Western Hemisphere. Genus with more than 10 species included (Mader, 1958). Only three species are recorded from North America, *C. sanguinea*, *C. munda*, and *C. polita*.

Natural history. — Both larvae and adults are predaceous on aphids and scale insects. Life history of *C. polita* Casey was described by Palmer (1914).

Cycloneda polita Casey

Cycloneda polita Casey, 1899:93. Type locality: None specified. "California, Washington State, British Columbia, and Idaho."

Cycloneda polita flava Timberlake, 1943:24. Type locality: "Alameda, California." Type not studied.

Description. — Habitus and maculation as in Fig. 45. Body short oval, prominently convex. Color: head black with two whitish-yellow interocular spots; mouthparts and antennae light brownish-yellow; pronotum mostly black, maculate whitish-yellow; elytra orange-red, immaculate; Elytra: margins narrowly reflexed, beaded, epipleura not foveate. Legs: normal, tarsal claws appendiculate, with large basal quadrate tooth. Abdomen: metacoxal arcs incomplete, subparallel with sternal margin. TL 4.0 - 4.5 mm; W 3.5 mm.

Variation. — Color: from orange-brown or beige to deep red (85% of specimens examined).

Distribution. — Western North America, Fig. 136. Recorded from: southern Alberta, southern British Columbia, California, Idaho, Oregon, and Washington.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland, coniferous forest.

Number of specimens examined. — 76.

Genus *Coccinella* Linnaeus

Coccinella Linnaeus, 1758:364. Type-species: *Coccinella septempunctata* Linnaeus, 1758:365. Subsequently designated by Crotch, 1874:105. The designation of *Coccinella marginata* Fabricius, 1801 by Hope (1840:29) is invalid.

Coccionella Voet, 1806. Misspelling.

Spilota Bilberg, 1820:61. Type-species: *Coccinella undecimpunctata* Linnaeus, 1758:366. Subsequently designated by Timberlake, 1919:163. NEW SYNONYMY.

Note on synonymy. — *C. septempunctata* and *C. undecimpunctata* are in my opinion congeneric taxa. This is based on possession of shared characters (male genital armature, structure of female genitalia, as well as general body structure and color pattern, especially of pronotum and elytra) by adults of these two species. Thus, *Spilota* is a junior synonym of *Coccinella*.

Derivation of name. — From Latin, *coccineus*, *coccinus* = scarlet-colored; named in reference to elytral color.

Comparison. — Distinguished from other North American Coccinellini by combination of characters: pronotum mostly black, except yellowish-white anterior angles; orange-red color of elytra; details of male genital armature (figured by Dobzhansky, 1931); female genitalia (infundibulum present).

Description. — Medium to large Coccinellini (4.0 - 7.0 mm). Body broadly oval, moderately to prominently convex. Color: head black with two yellowish-white interocular spots, or transverse yellowish-white band; antennae and mouthparts brown to black; bases of mandibles in some species white; pronotum mostly black, maculate with trapezoidal or triangular white mark at anterior angles; front margin narrowly bordered white in some species; elytra yellow to orange-red, maculate or not, if maculate, pattern basically six spots on each elytron (Fig. 48); in some species spots either absent or confluent; ventral surface black, except episterna, epimera and metasternum white. Vestiture: dorsal surface glabrous, except setose head; ventral surface and legs setose. Sculpture: head and pronotum distinctly punctate, shagreened (Fig. 79); elytra unequally punctate, shiny. Thorax: prosternum with two carinae, convergent anteriorly. Elytra: margins narrowly reflexed; epipleura not foveate. Legs: tibiae each with two prominent spurs at distal end; tarsal formula 4-4-4; claws with prominent tooth at base. Abdomen: metacoxal arcs divided into two branches, first subparallel with sternal margin, second recurved antero-laterally. Male genitalia (figured by Dobzhansky, 1931:3, 5): siphon arcuate, siphonal capsule well developed in most species, rudimentary in *C. undecimpunctata* and *C. fulgida*; basal lobe is shape species-specific (figured by Brown, 1962:795); lateral lobes each shorter or equal in length with basal lobe, setigerous distally. Female genitalia: (figured by Dobzhansky, 1931:12); spermatheca sclerotized, arcuate cylinder; accessory gland large; infundibulum well developed;

Distribution. — Holarctic Region, with 11 species described for North America, 10 for the Palearctic region. Center of diversity seems to be in northwestern North America. The following five species are common to the Holarctic Region: *C. transversoguttata*, *C. monticola*, *C. trifasciata*, *C. hieroglyphica*, *C. undecimpunctata*. In North America, the number of species markedly decreases southward. From Mexico only four species are recorded: *C. novemnotata*, *C. californica*, *C. monticola*, and *C. nugatoria* (Brown, 1967). In southern latitudes this genus is replaced by species of *Cycloneda* Crotch.

Natural history. — Immature stages for most North American species were described by Palmer (1914), with some notes on larval habits. Both larvae and adults are predaceous on Aphidae. For additional references see Hodek (1966, 1973).

Systematic studies. — The North American species of this genus have been studied by Casey (1899), Leng (1903), Dobzhansky (1931), and Brown (1962, 1967). Dobzhansky (1925a and b, 1926a) redefined this genus as it is understood today.

Key to adults of the species of *Coccinella* from western Canada and Alaska

- | | | | |
|----|------|--|--------------------------------------|
| 1 | (0) | Interocular area pale yellow; anterior margin of pronotum above eyes pale yellow | 2 |
| 1' | | Interocular area with two pale spots; anterior margin of pronotum above eyes black | 3 |
| 2 | (1) | Body length ca. 5.0 mm; elytral suture not pigmented black | <i>C. trifasciata</i> L., p. 336 |
| 2' | | Body length ca. 7.0 mm; elytral suture narrowly pigmented black | <i>C. novemnotata</i> Herbst, p. 334 |
| 3 | (1') | Elytral suture narrowly pigmented black | 4 |
| 3' | | Elytral suture not pigmented black | 6 |
| 4 | (3) | Pronotum with anterior angles rounded, yellowish-white mark large, extended medially | <i>C. prolongata</i> Cr., p. 337 |

- 4' Pronotal anterior angles acute, yellowish-white mark small, not extended medially 5
- 5 (4') Body length ca. 5.0 mm; alpine zone of Rocky Mountains *C. alta* Brown, p. 332
- 5' Body length ca. 7.0 mm; Pacific coast *C. californica* Mann., p. 336
- 6 (3') Each elytron maculate in addition to scutellar spot or transverse band with one/two transverse discal spots/bands, and subapical spot 7
- 6' Each elytron maculate in addition to scutellar spot with five separate spots Pacific coast *C. undecimpunctata* L., p. 335
- 7 (8) Each elytron maculate with two post-scutellar spots/bands 8
- 7' Each elytron maculate with single, relatively large, subapical spot; scutellar band uniquely tricusate (Fig. 58) *C. hieroglyphica* L., p. 334
- 8 (7) Each elytron maculate with prominent round scutellar spot, prominent transverse discal band extended obliquely almost from suture to lateral margin, and round/oval subapical spot 9
- 8' Each elytron maculate with distinct scutellar transverse band (Fig. 50), relatively short transverse discal dash, not extended over 0.50 width of elytron, and relatively small subapical spot *C. transversoguttata*, Fald., p. 333
- 9 (8) Size - TL 5.2-7.2 mm. Each elytron prominently maculate with round discal spot, oblique transverse discal spot extended nearly from suture to lateral margin *C. monticola* Muls., p. 333
- 9' Size - TL 4.5-5.0 mm. Each elytron maculate with round scutellar spot, small sublateral spot at 0.40 joined with transverse median spot to form relatively narrow oblique band, and relatively small subapical spot. Arctic, subarctic North America *C. fulgida* Watson, p. 335

Coccinella alta Brown

Coccinella suturalis Casey, 1899:89. Not Olivier, 1791. Type locality: "Colorado." NEW SYNONYMY.

Coccinella alta Brown, 1962:798. Type locality: "Alta, Salt Lake Co., Utah." Holotype in USNM. Paratypes: 2 in CNC, No. 7782.

Note on synonymy. — *C. suturalis* was described from a female specimen. The name is a primary junior homonym, thus not available. Brown (1962) when describing *C. alta* as new species indicated, but was doubtful about the above synonymy. I consider *C. suturalis* Casey conspecific with *C. alta* Brown, based on a variety of shared characteristics, especially narrowly pigmented suture of elytra.

Comparison. — Some specimens of this species resemble small specimens of *C. monticola* from which they can be distinguished by narrowly pigmented, black elytral suture.

Description. — Habitus and maculation as in Fig. 46. Color: head black, with two well separated, interocular white spots; pronotum mostly black, except anterior angles maculate with yellowish-white spots, anterior margin pigmented black at middle; elytra reddish-orange, maculate with black spots; each elytron with oblique submedian spot and transversely oval apical spot; sutural margin narrowly pigmented black; ventral surface and legs black, except mesepimera white. Male genitalia (figured by Brown, 1962): basal lobe gradually but distinctly narrowed, longer than lateral lobes. TL 4.8 - 5.3 mm; W 3.2 - 4.0 mm.

Distribution. — Western North America, Fig. 137. Recorded from: mountains of Alberta, British Columbia, California, Colorado, Idaho, Montana, Utah, and Wyoming.

Collecting and natural history notes. — Habitat: alpine and subalpine tundra; specimens collected from elevations 4,000 to 11,000 ft (1,350 to 3,500 m).

Number of specimens examined. — 23.

Coccinella monticola Mulsant

Coccinella monticola Mulsant, 1850:115. Type locality: "Rocky Mountains." Type not studied.

Coccinella lacustris LeConte, 1852:131. Type locality: "Lake Superior." Synonymized by Dobzhansky, 1931:14.

Coccinella nevadica Casey, 1899:88. Type locality: "Reno, Nevada." Synonymized by Leng, 1903:201.

Coccinella alutacea Casey, 1899:89. Type locality: "New Mexico." Type in USNM. Synonymized by Dobzhansky, 1931:17.

Coccinella impressa Casey, 1899:89. Type locality "California." Type in USNM. Synonymized by Dobzhansky, 1931:17.

Coccinella nivicola monticola: Dobzhansky, 1931:17. Misidentification.

Coccinella transversoguttata alutacea: Leng, 1903:200. Misidentification.

Coccinella monticola alutacea: Johnson, 1910:63.

Coccinella monticola sellica Johnson, 1910:63. Type locality: Not specified. "California and New Hampshire."

Coccinella monticola postica Johnson, 1910:63. Not *Coccinella postica* Mulsant, 1850. Type locality: "California."

Synonymized by Brown, 1962:802.

Coccinella monticola confluenta Johnson, 1910:63. Type locality: "California." Synonymized by Brown, 1962:802.

Coccinella monticola biguttata Johnson, 1910:63. Not *C. biguttata* Fabricius, 1787. Type locality: "Buena Vista, Colorado." Synonymized by Brown, 1962:802.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: large size (TL 5.2-7.2 mm); elytral maculation (similar to that of *C. alta* Fig. 46); details of male genital armature (figured by Brown, 1962:795).

Description. — Habitus and maculation similar as in *C. alta*, but specimens are much larger (Fig. 46). Color: head black, with two small, well separated, interocular spots; pronotum mostly black, except anterior angles maculate with yellowish-white, trapezoidal spots; anterior margin pigmented black at middle; elytra reddish-orange, maculate with black spots; each elytron with prominent, oblique spot near middle and transverse apical spot; elytral suture not pigmented. Male genitalia (figured by Brown, 1962:795): median lobe gradually tapered to point; apical portion broader than in *C. alta*, lateral lobes shorter than median lobe. TL 5.2 - 7.2 mm; W 4.2 - 5.2 mm.

Variation. — Variation in elytral maculation is probably clinal. Specimens from southwestern areas have the elytral spots reduced (California, Oregon), or missing entirely (Nevada).

Distribution. — Widely ranging in North America, Fig. 138. Recorded from: Alaska, Alberta, Arizona, British Columbia, California, Colorado, Idaho, Kansas, Maine, Manitoba, Michigan, Minnesota, Montana, Nevada, New Brunswick, New Hampshire, New Mexico, New York, Nova Scotia, Ontario, Oregon, Pennsylvania, Quebec, Saskatchewan, South Dakota, Utah, Washington, Wisconsin, and Wyoming.

Collecting and natural history notes. — Habitat: parkland, mixed and coniferous forests.

Number of specimens examined. — 68.

Coccinella transversoguttata Falderman

Coccinella transversoguttata Falderman, 1835:454. Type locality: "Siberia." Type not studied.

Coccinella quinque-notata Kirby, 1837:230. Not Haworth, 1812. Type locality: "54°", Cumberland House, Saskatchewan. Synonymized by Dobzhansky, 1931:14, 15.

Coccinella ephippiata Zetterstedt, 1838:235. Type locality: "Greenland." Type not studied.

Coccinella transversalis Mulsant, 1850:117. (in part). Synonymized by Dobzhansky, 1931:14. Type not studied.

Coccinella 5-notata: Fitch, 1862:849. Unjustified emendation.

Coccinella transversoguttata richardsoni Brown, 1962:790.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: size (TL 5.0-7.5 mm); general habitus and maculation (Fig. 50); and transcontinental distribution in temperate North America (Fig. 139).

Description. — Habitus and maculation as in Fig. 50. Color: head black, with two well separated, interocular white spots; pronotum mostly black, except anterior angles maculate with yellowish-white, trapezoidal spots, and anterior margin pigmented black at middle; elytra reddish-orange, maculate with black spots; sub-basal band composed of coalescent humeral and scutellar spots, in some specimens reduced to scutellar spot only; each elytron with median and subapical transverse spot, infrequently with small sublateral spot at basal 0.40; ventral surface and legs black, except mesepimera white, metepimera pale to black. Male genitalia (figured by Brown, 1962:795): apical portion of basal lobe hastate, extended well beyond apices of lateral lobes. TL 5.0 - 7.5 mm; W 4.5 - 5.8 mm.

Distribution. — Holarctic Region. Widely ranging in North America, Fig. 139. Recorded

from most Canadian provinces and states of United States.

Collecting and natural history notes. — Habitat: parkland, mixed and coniferous forests. Hosts: Homoptera — *Cinara brevispinosa* (G.&P.) on *Pinus*; *Acyrtosiphon pisum* (Harris) on *Trifolium*; *Brachyacaudus cardui* on *Cirsium*; *Chaitophorus populicola* Thomas on *Populus balsamifera*; *Aphis* species complex, on *Epilobium canadensis*; psyllid nymphs on *Alnus*.
Number of specimens examined. — 850.

Coccinella hieroglyphica Linnaeus

Coccinella hieroglyphica Linnaeus, 1758:365. Type locality: "Suecia." Type not studied.

Coccinella tricuspis Kirby, 1837:231. Not Thunberg, 1795. Type locality: None given. Type probably in BMNH. Synonymized by Dobzhansky, 1926:20.

Coccinella mannerheimi Mulsant, 1850:106. Type locality: "Siberia." Type not studied. Synonymized by Dobzhansky, 1926:21.

Coccinella kirbyi Crotch, 1874:37. Unnecessary replacement name for *C. tricuspis* Kirby, 1837:231.

Coccinella humboldtiensis Nunenmacher, 1912:448. Type locality: "Crescent City, Del Norte Co., California." Type in CAS. Synonymized by Dobzhansky, 1931:27.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: size (TL 3.7-4.7 mm); general habitus and maculation (Fig. 58); transcontinental range in western North America (Fig. 140).

Description. — Habitus and maculation as in Fig. 58. Color: head black, with two well separated, interocular white spots; pronotum mostly black, with anterior margin pale at middle, in some specimens this pale band very narrowly interrupted by median stripe; elytra reddish-orange, maculate with black spots; tricusgate sub-basal band prominent and with large, transverse spot at apical 0.25; elytral suture not pigmented; mesepimera brown; metepimera black. Male genitalia (figured by Dobzhansky, 1931): basal lobe elongate, triangular in dorsal aspect, apex bluntly pointed; lateral lobes equal in length to basal lobe. TL 3.7 - 4.7 mm; W 4.0 mm.

Distribution. — Holarctic Region. Widely ranging in temperate North America, Fig. 140. Recorded from: Alaska, Alberta, British Columbia, California, Idaho, Manitoba, Michigan, Minnesota, Montana, North Dakota, Northwest Territories, Ontario, Oregon, Quebec, Saskatchewan, South Dakota, Washington, and Yukon.

Collecting and natural history notes. — Habitat: parkland and mixed and coniferous forests.

Number of specimens examined. — 235.

Coccinella novemnotata Herbst

Coccinella 9-notata Herbst, 1793:269. Type locality: "North America." Type not studied.

Coccinella franciscana Mulsant, 1853:147. Type locality: "California." Type not studied. Synonymized by Dobzhansky, 1931:8.

Coccinella degener Casey, 1899:88. Type locality: "Fort Wingate, New Mexico." Type in USNM. Synonymized by Dobzhansky, 1931:6.

Comparison. — Distinguished from other North American *Coccinella* species by characters given in the above key.

Description. — Habitus and maculation as in Fig. 47. Color: head black with broad, white interocular band; pronotum mostly black, except anterior angles and margin narrowly yellowish-white; elytra reddish-orange, maculate with black spots; each elytron with five distinct spots that decrease in size in western populations; sutural margin very narrowly pigmented black; ventral surface and legs black, except mesepimera and metepimera white to infuscate. Male genitalia: apical portion of basal lobe broadly triangular, separated from it by large notch on each side; lateral lobes shorter than basal lobe. TL 4.0 - 7.0 mm; W 3.5 - 5.0 mm.

Variation. — The variation in elytral maculation is probably clinal. Typical *C. novemnotata* is represented by eastern specimens, with distinctly maculate elytra. Specimens with elytral maculation reduced except for the scutellar spot were described as *C. franciscana* from California. *C. degener* and *C. oregona* were described based on indistinctly maculate specimens from the Pacific coastal region.

Distribution. — Widely ranging in North America, Fig. 141. Recorded from: Alabama, Al-

berta, Arizona, Arkansas, British Columbia, California, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Manitoba, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Northwest Territories, Ohio, Oklahoma, Ontario, Oregon, Pennsylvania, Quebec, Rhode Island, Saskatchewan, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland. Hosts: *Macrosiphum pisi* (Harris); *Therioaphis maculata*; according to McMullen, 1967.

Number of specimens examined. — 578.

Coccinella fulgida Watson

Coccinella nugatoria: Leng, 1919:17. Misidentification.

Coccinella undecimpunctata: Dobzhansky, 1931:28. Misidentification.

Coccinella fulgida Watson, 1954:45. Type locality: "Cape Henrietta Maria, Ontario." Holotype in CNC, No. 6146.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: size (TL 4.5-5.0 mm); maculation of elytra (Fig. 53); geographic range in subarctic North America (Fig. 144).

Description. — Habitus and maculation as in Fig. 53. Color: head black, with two well separated, interocular white spots; pronotum mostly black, except anterior angles yellowish-white; anterior margin pigmented black at middle, anterior angles maculate with white trapezoidal mark; elytra reddish-orange, maculate with black spots; each elytron with small to relatively large scutellar spot, small sublateral spot at 0.40 joined with transverse median spot to form oblique dash, transverse apical spot; sutural margin not pigmented black; ventral surface and legs black, except mesepimera white to black. Male genitalia (figured by Watson, 1954): basal lobe subparallel basally, constricted to form acute apex, lateral lobes equal in length with basal lobe. TL 4.5 - 5.0 mm; W 3.8 - 4.0 mm.

Variation. — Specimens of several other species somewhat resemble specimens of *C. fulgida*. Of these, *C. undecimpunctata*, *C. hieroglyphica humboldtiensis*, and *C. monticola* have ventral white spot of each anterior pronotal angle large, trapezoidal and extended posteriorly as far as dorsal spot. In *C. difficilis*, body is more convex and specimens are on average larger. In *C. alta* the sutural margins of elytra are pigmented black. Brown (1962) pointed out that *C. fulgida* may have an unusual sex ratio. From 20 specimens studied by him, only 3 were males.

Note. — The Alaskan specimens in USNM were misidentified by Dobzhansky (1931) as *C. undecimpunctata*. Chapin (1956) misidentified this species for *C. difficilis*. Leng (1919) reported this species as *C. nugatoria* from Langston Bay and Kater Point, Bathurst Inlet, Northwest Territories.

Distribution. — Arctic and subarctic North America, Fig. 144. Recorded from: Alaska, northern British Columbia, northern Ontario, northern Quebec, Northwest Territories, and Yukon.

Collecting and natural history notes. — Habitat: arctic, subarctic tundra, tundra-boreal forest.

Number of specimens examined. — 23.

Coccinella undecimpunctata Linnaeus

Coccinella 11-punctata Linnaeus, 1758:366. Type locality: "Europe." Type not studied.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: size (TL 4.0-5.0 mm) and maculation (Fig. 48). Palearctic species introduced to North America.

Description. — Habitus and maculation as in Fig. 48. Color: head black, with two well separated, interocular white spots; pronotum mostly black, except anterior angles yellowish-white, anterior margin pigmented black at middle; elytra reddish-orange, maculate with black spots; each elytron with five other, small but distinct black spots, elytral suture not pigmented; ventral surface and legs black, except mesepimera white, metepimera pale to black, infusate. TL 4.0 - 5.0 mm; W 3.0 mm.

Larva described by Emden (1949:276).

Variation. — Color and pigmentation: elytral spots (humeral, sublateral) reduced or missing from some specimens.

Distribution. — Holarctic Region, northern Africa, Iceland but not Greenland, introduced to North America. Recorded from: eastern coast (Schaeffer, 1912); Maine, Massachusetts, New Brunswick, Newfoundland, New Jersey, New York, Nova Scotia, Ontario, Prince Edward Island, and Quebec. Western coast (1970), southern British Columbia, and Washington (Fig. 144).

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), seashore grassy communities, and parkland. Especially common near seashore, on grasses and other herbaceous vegetation, including woody plants, e.g., *Salix*, and *Betula* species. I collected adults of this species in Vancouver, British Columbia, from aphid-infested *Medicago sativa* plants in English Bay, almost at sea level.

Number of specimens examined. — 48.

Coccinella californica Mannerheim

Coccinella californica Mannerheim, 1843:312. Type locality: "California." Type not studied.

Coccinella johnsoni Casey, 1908:403. Type locality: "San Diego, California." Type in USNM. NEW SYNONYMY.

Note on synonymy. — *C. johnsoni* was described based on a maculate specimen of *C. californica*. Casey (1908) in description of this species remarked that he originally considered this specimen to be "a spotted modification of *C. californica*." Dobzhansky (1931) referred to *C. californica* indistinctly maculate specimens, which Brown (1962) treated as *C. johnsoni*. Brown (1962) further noted that *C. californica* and *C. johnsoni* are separable only by elytral maculation. The male genital armature of specimens referred to either species is identical. The individuals from British Columbia and Washington are intermediate between distinctly maculate specimens from California, and immaculate specimens of typical morph of *C. californica*. Based on the extent of variation in maculation of elytra, and the structure of male genital armature, I consider *C. johnsoni* conspecific with *C. californica*. Thus the name *C. johnsoni* is a junior synonym of the name *C. californica*.

Comparison. — Specimens of *C. californica* resemble some of *C. novemnotata*, which differ in having interocular region and anterior pronotal margin white.

Description. — Habitus and maculation as in Fig. 51, 54. Color: head black, two well separated, interocular spots; pronotum mostly black, except anterior angles yellowish-white; anterior margin pigmented black at middle; elytra reddish-orange, maculate with scutellar spot small, humeral and median spots in some specimens indistinct; sublateral spot at 0.40; one or two subapical spots; elytral suture narrowly pigmented black; ventral surface and legs black, except mesepimera white, metepimera black. Male genitalia (figured by Brown, 1962): apical portion of basal lobe broadly triangular, separated from it by small notch on each side, lateral lobes shorter than basal lobe. TL 5.0 - 6.8 mm; W 3.9 - 4.7 mm.

Distribution. — Pacific coast of North America, Fig. 142. Recorded from: Alaska, Alberta, Arizona (Dobzhansky, 1931), British Columbia, California, Iowa, Missouri (Wingo, 1952), Oklahoma (Brown, 1962), Oregon and Washington.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), and parkland, generally on aphid infested plants west of Continental Divide. Individual specimens appear from time to time east of the Rocky Mountains, but these were most probably transported there by human agency. This is the most plausible explanation for single records of adults far away from the species' breeding range. Wingo (1952), reported single adult specimens from Iowa and Missouri, and suggested that these were carried there with shipments of fruits and vegetables.

Number of specimens examined. — 224.

Coccinella trifasciata Linnaeus

Coccinella trifasciata Linnaeus, 1758:365. Type locality: Lapland. Type in BMNH, not studied.

Coccinella perplexa Mulsant, 1850:1022. Type locality: "l'Amerique septentrionale." Synonymized by Dobzhansky, 1931:22.

Coccinella subversa LeConte, 1854:19. Type locality: Oregon. Synonymized by Dobzhansky, 1931:23.

Coccinella barda LeConte, 1859:286. Type locality: Punto de los Reyes, Marin Co; California. Synonymized by Crotch, 1873:370.

Coccinella eugenii Mulsant, 1866:95. Type locality: California. Type not studied. Synonymized by Dobzhansky, 1931:24.

Coccinella juliana Mulsant, 1866:141. Type locality: California. Type not studied. Synonymized by Dobzhansky, 1931:23.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: yellowish-white interocular area, anterior margin of pronotum above eyes pale yellow; size (TL 4.8-5.1 mm); maculation (Fig. 52).

Description. — Habitus and maculation as in Fig. 52, 54. Color: head black, with two separated or confluent interocular white spots; pronotum mostly black, anterior margin white at middle, except in some females; elytra reddish-orange, maculate with three, black fasciae; median and subapical fascia interrupted at suture; elytral suture not pigmented; ventral surface and legs black, except mesepimera and metepimera white. Male genitalia (figured by Dobzhansky, 1931): apical portion of basal lobe slender, equal in length with lateral lobes. TL 4.8 - 5.1 mm; W 3.8 - 4.0 mm.

Variation. — Some authors considered the Eurasian and North American populations to be specifically distinct, based on the differences in color and maculation. As Brown (1962) pointed out, these characters vary geographically, almost clinically. Dobzhansky (1931) demonstrated that variants of *C. trifasciata* overlap in distribution in North America, and the tendency for reduced pigmentation of elytra is also known in specimens from southern Siberia and Mongolia.

Distribution. — Holarctic Region. In North America transcontinental (Fig. 145). Recorded from most provinces in Canada, and in most states in United States.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland, boreal forest.

Number of specimens examined. — 540.

Coccinella prolongata Crotch

Coccinella prolongata Crotch, 1873:371. Type locality: None specified, here restricted to Utah.

Coccinella bridwelli Nunenmacher, 1913:76. Type locality: "Tahquitz Valley, San Jacinto Mountains; California." Type in CAS. Synonymized by Dobzhansky, 1931:11.

Coccinella prolongata sequioae Dobzhansky, 1931:10. Type locality: "near Camp Wolverton, 7,000 to 9,000 ft; Sequoia National Park, California." Type in CAS, not studied.

Comparison. — Distinguished from other North American *Coccinella* species by combination of characters: general habitus and maculation (Fig. 49); size (TL 5.7-7.0 mm); details of male genital armature (figured by Brown, 1962:795).

Description. — Habitus and maculation as in Fig. 49. Color: head black, with two large, interocular white spots; pronotum mostly black, except anterior angles with large, trapezoidal, white markings, wider than in any other *Coccinella* species; pigmentation of pronotum reduced to broad basal band and parallel sided median stripe; elytra reddish-orange, maculate with black spots; each elytron with small submarginal spot near mid-line, and apical spot; sutural margin very narrowly pigmented dark-brown; ventral surface and legs black, except mesepimera and metepimera white to infusate. Male genitalia (figured by Dobzhansky, 1931): median lobe with apical portion broadly triangular in dorsal aspect, similar to that of *C. californica* but separated from basal portion by much larger, deeper notch, lateral lobes shorter than median lobe. TL 5.7 - 7.0 mm; W 4.7 mm.

Variation. — Melanism was observed in some Californian specimens. *C. sequioae* was described based on specimens with scutellar spot large; each elytron with very large, irregular black spot at apical 0.60. Recorded from Mono County only, *C. bridwelli* was described based on specimens with elytra entirely black.

Distribution. — Western North America, Fig. 143. Recorded from: southern Alberta, southern British Columbia, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, Oregon, Washington, Wyoming and Utah.

Collecting and natural history notes. — Habitat: In the study area, only six specimens were collected in southernmost Alberta, and British Columbia.

Number of specimens examined. — 6.

Genus *Hippodamia* Dejean

Hippodamia Dejean, 1836:456. Type-species: *Coccinella tredecimpunctata* Linnaeus, 1758:365. Subsequently designated by Crotch, 1874:94.

Adonia Mulsant, 1846:39. Type-species: *Coccinella mutabilis* Scriba, 1790:183. (= *C. variegata* Goeze, 1777:247). Designated by Mulsant (1846:39) through monotypy. NEW SYNONYMY.

Hemisphaerica Hope, 1840:157. Type-species: *Coccinella quinquesignata* Kirby, 1837:230. Originally designated. NEW SYNONYMY.

Ceratomegilla Crotch, 1873:365. Type-species: *Ceratomegilla ulkei* Crotch, 1873:365. Fixed by monotypy. The designation of *Coccinella maculata* DeGeer, 1775:392 by Korschefsky (1932:312) is invalid. NEW SYNONYMY.

Spiladelpha Semenov and Dobzhansky, 1923:99. Type-species: *Spiladelpha barovskii* Semenov and Dobzhansky, 1923:99. Subsequently designated by Mader, 1926:87. Synonymized by Brown and de Ruette, 1962:646.

Notes on synonymy. — As pointed out by Brown and de Ruette (1962), the characters used to distinguish members of *Adonia* and *Hippodamia* fail in some North American species. Specimens of *Adonia* species are supposedly characterized by: pronotal base margined with a distinct bead; metacoxal arcs complete, well impressed; males with first segment of front and middle tarsi markedly dilated. However, metacoxal arcs are constantly obscured or absent from members of *H. tredecimpunctata*, *H. americana*, *H. falcigera*, *H. washingtoni*, and present in most but not all specimens of other North American species. Males of *H. sinuata*, *H. oregonensis*, and *H. caseyi* possess markedly dilated first segment of front and middle tarsi. Based on this inconsistency of characters, *H. variegata*, and *H. tredecimpunctata* are in my opinion congeneric taxa. Thus, *Adonia*, is a junior synonym of *Hippodamia*.

C. tredecimpunctata and *C. quinquesignata* are in my opinion congeneric taxa. This conclusion is based on possession of characters of male genital armature, cleft tarsal claws, as well as general body structure and color pattern in specimens of these two species. Thus, *Hemisphaerica* is a junior synonym of *Hippodamia*.

The genus *Ceratomegilla* was described by Crotch (1873) from a single male specimen. The diagnostic characters given to separate members of this genus from *Hippodamia* were as follows: pronotum sinuate and beaded at base; antennae unique, third article "broadly dilated at apex, with the inner angle ciliate." Scott (1933) noted that the modified (dilated) third antennal article is a male character. As pointed out by Brown and de Ruette (1962), for 60 years the type-species was known from the holotype only. As a result, *Ceratomegilla* was confused with other genera, and the genus remained inadequately defined. Based on the structure of the male genital armature, as well as general body structure, it is evident that *Ceratomegilla* Crotch as represented by its type-species, *C. ulkei*, is a member of the genus *Hippodamia*. Thus, the name *Ceratomegilla* Crotch is a junior synonym of the name *Hippodamia*.

Derivation of name. — *Hippodamia* from Greek, mythical name. First used by Dejean (1836), who credited its origin to Chevrolat.

Comparison. — Distinguished from other North American Coccinellini by combination of: color of elytra from yellow-orange to orange-red; middle and hind tibiae with two prominent spurs each; tarsal claws appendiculate, notched; details in structure of male genital armature (as indicated below, and see plate A, p. 290, and Plate B, p. 341.)

Description. — Coccinellini of small to medium size (3.0 - 7.5 mm). Body form: elongate oval, oblong. Color: head black, except frons with interocular yellowish-white band or spots; mouthparts and antennae light brownish-yellow, in members of some species brown; pronotum mostly black, except lateral and anterior margins yellowish-white (in *H. moesta* specimens only anterior angles yellow-white). In members of some species, black discal area with V-shaped, yellowish-white vittae; elytra from yellow to orange-red, maculate with black spots or longitudinal bands; in members of some species, pigmentation reduced or coalescent and elytrae mostly black; ventral surface and legs black, except mesepimera and metepimera white, tibiae and tarsi light brownish-yellow in some species. Vestiture: dorsal surface glabrous, except head, antennae and mouthparts setose, ventral surface and legs setose. Sculpture: head distinctly punctate, shagreened; in members of some species, punctures large, unequal; pronotum and elytra distinctly punctate, shagreened; in members of some species punctures large, unequal and coalescent. Head: antennae of 11 articles each, relatively long, clavate; mandibles bifid at apex; maxillary palpus of 3 articles ultimate article triangular; labial palpus of 3 articles, slender and cylindrical. Thorax: pronotum convex, recessed

above eyes; lateral margins shallowly reflexed; Elytra: apex in members of some species acute; lateral margin narrowly but distinctly reflexed. Legs: middle and hind tibiae with two prominent spurs distally; tarsal formula 4-4-4, each claw with basal tooth or prominently cleft, bifid. Abdomen: metacoxal arcs complete, distinctly impressed, obscure or absent in members of some species. Male genitalia (see Plate A, p. 290): median lobe (siphon) arcuate tube, without siphonal capsule; basal lobe variously modified at apex, modification species-specific (see Plate B). Female genitalia (figured by Chapin, 1946): spermatheca sclerotized, arcuate cylinder; accessory gland large; infundibulum present.

Distribution. — Holarctic Region. Predominantly North American genus with more than 25 species described for the world (Chapin, 1946; Kapur, 1968).

Natural history. — Both larvae and adults are predaceous on aphids and mites. Vaundell and Storch (1972) listed names of hosts. The life cycle of the more common species was described by Palmer (1914).

Systematic studies. — The North American species of this genus have been studied by: Brown and de Ruelle (1962); Casey (1899, 1908); Chapin (1946); Crotch (1873); Leng (1903); Timberlake (1919); and Wingo (1952). Dobzhansky (1926b) included *Hippodamia* in a distinct subtribe. Hatch (1962) and Brown and de Ruelle (1962) raised the rank to part of a tribe.

Species identification. — Because of extensive variation in color pattern, definitive identification of adults is best achieved by examination of the male genitalia. Therefore, the following key uses mainly genitalic features. Illustrations are provided on Plate B (p. 341). Males are recognized by a median emargination of the posterior margin of the penultimate (fifth) abdominal sternum.

Typical members of each species can be identified by color pattern, and generally, specimens can be rough-sorted on this basis. Fig. 55 to 70 illustrate such patterns.

Key to adults of the *Hippodamia* species from western Canada and Alaska

- 1 (0) Each tarsal claw with subrectangular basal tooth. Base of pronotum with marginal bead fine and entire *H. ulkei* Crotch, p. 340
- 1' Each tarsal claw cleft near middle, tooth sharply pointed. Base of pronotum not beaded 2
- 2 (1') Tibiae and tarsi of all legs yellowish-brown, femora black. Each elytron maculate with seven separate black spots. Male genitalia as in Fig. B1 *H. tredecimpunctata* (L.), p. 342
- 2' Legs brownish-black to black, or with only tarsi brownish-yellow 3
- 3 (2') Pronotum at base with more or less well developed pale median spot 4
- 3' Pronotum black at base, without median pale spot 7
- 4 (3) Male genitalia: basal lobe with apical protuberance in shape of arrow head (Fig. B5) *H. parenthesis* (Say), p. 343
- 4' Apical protuberance of basal lobe not in shape of arrow head, sides parallel or sloped 5
- 5 (4') Male genitalia: ventral alae large, protruded laterally; apical 0.33 of basal lobe with sides rounded (Fig. B3) *H. falcigera* Crotch, p. 342
- 5' Ventral alae less developed, basal lobe not expanded apically, sides sloped obliquely 6
- 6 (5') Male genitalia: basal lobe terminated in long slender process, as in Fig. B8 *H. lunatamaculata* Motschulsky, p. 345
- 6' Apical protuberance of basal lobe shorter, as in Fig. B7 *H. apicalis* Casey, p. 344
- 7 (3') Male genitalia: parameres longer than basal lobe; latter with very broad, oblique apical portion, apical margin ridged (Fig. B15) *H. sinuata* Mulsant, p. 349
- 7' Parameres and basal lobe subequal in length, apical portion narrower 8

- 8 (7') Male genitalia: basal lobe with apical protuberance in form of arrow head (Fig. B6) *H. arctica* (Schneider), p. 344
- 8' Basal lobe with apical protuberance less prominent, not expanded laterally 9
- 9 (8') Male genitalia: ventral alae large, prominent, projected laterally near base as in Fig. B2 10
- 9' Ventral alae less conspicuous, or inconspicuous from dorsal aspect 11
- 10 (9') Male genitalia: basal lobe expanded in apical 0.33; apical protuberance short, truncate (Fig. B4) *H. washingtoni* Timberlake, p. 343
- 10' Basal lobe narrowed and sides sloped medially toward apical protuberance, latter narrowed (Fig. B2) *H. americana* Crotch, p. 342
- 11 (9') Male genitalia: basal lobe with dorsal crest; ventral alae not evident near apex, as in Fig. B10 12
- 11' Basal lobe without dorsal crest; ventral alae evident each side of apex (Fig. B13) 13
- 12 (11') Male genitalia: basal lobe apically more gradually attenuate; dorsal crest deeply and broadly emarginate (Fig. B10) *H. glacialis* (Fab.), p. 346
- 12' Basal lobe more abruptly tapered, dorsal crest entire and slightly rounded (Fig. B9) *H. quinquesignata* (Kirby), p. 345
- 13 (11') Male genitalia: basal lobe very broad, parameres markedly arcuate (Fig. B13) *H. caseyi* Johnson, p. 348
- 13' Basal lobe narrower, parameres not strongly curved 14
- 14 (13') Male genitalia: basal lobe with terminal protuberance broader, less arcuate; parameres almost straight (Fig. B14) *H. oregonensis* Crotch, p. 348
- 14' Basal lobe with terminal protuberance narrower, parameres longer, more strongly curved 15
- 15 (14') Male genitalia: basal lobe broader at base, wedge-like in outline; terminal protuberance longer (Fig. B11) *H. moesta* LeConte, p. 347
- 15' Basal lobe slightly constricted near base, generally narrower; apical protuberance shorter (Fig. B12) *H. convergens* Guérin Ménèville, p. 347

Hippodamia ulkei (Crotch)

Ceratomegilla ulkei Crotch, 1873:365. Type locality: "Hudson's Bay." Type not studied.

Hippodamia parva Watson, 1954:45. Type locality: "Cape Henrietta Maria, Ontario." Holotype in CNC, No. 6147/slide No. 3131. NEW SYNONYMY.

Ceratomegilla parva: Brown and de Ruette, 1962:647.

Note on synonymy. — Upon examination of type specimen I consider *H. parva* conspecific with *C. ulkei*, based on the identical structure of the male genital armature. Brown and de Ruette (1962) when transferring *H. parva* to *Ceratomegilla* indicated the possibility of conspecificity with *C. ulkei* but did not decide.

Description. — Habitus and color pattern as in Fig. 57, or elytra maculate. Color: head black with two interocular, whitish-yellow spots; mouthparts and antennae light brown; pronotum mostly black, except lateral margins narrowly yellowish-white; elytra mostly black, except base and margins orange-yellow; suture black, narrowly bordered orange-yellow at apical 0.40; ventral surface and legs black. Tarsi brownish. Vestiture: dorsal surface distinctly punctate, shagreened, dull. Punctures unequal, coalescent. Pronotum: margins narrowly beaded. Elytra: lateral margins narrowly reflexed. Legs: tarsal claws appendiculate, notched at base. Male genitalia (figured by Watson, 1954): siphon arcuate; lateral lobes each shorter than basal lobe; alae small, as in *parenthesis* group. Female genitalia (figured by Watson, 1954): spermatheca arcuate cylinder; accessory gland relatively large. TL 3.8 - 4.7 mm; W 2.8 - 3.0 mm.

Variation. — Males are distinguished by dilated antennal article 3 (triangular) and dilated basal articles of front and middle tarsi. *H. parva* was described based on a non-melanic specimen, with spots on elytra reduced and elytral color therefore predominantly orange-yellow (eastern subarctic region).

PLATE B

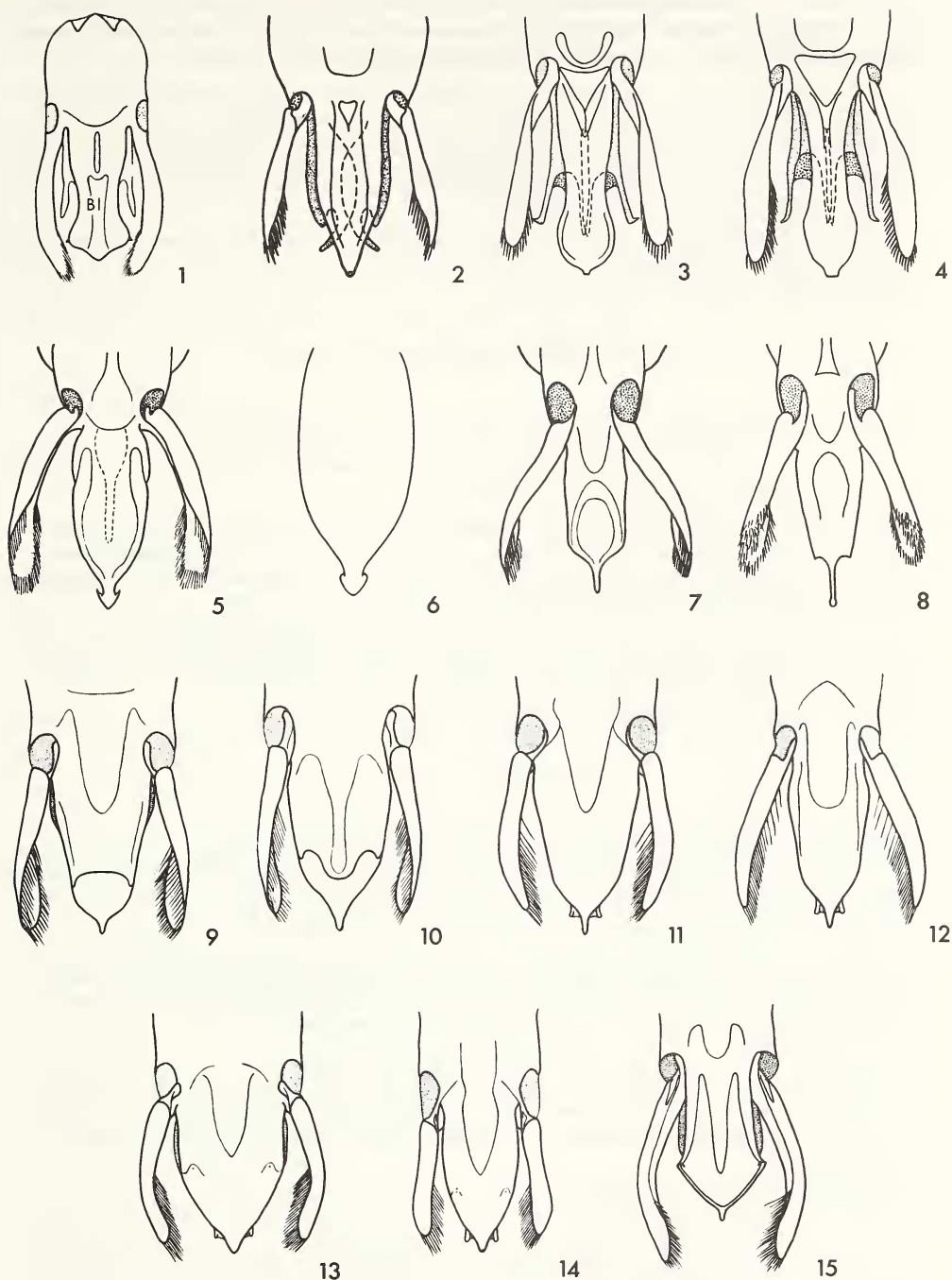


Plate B. Male genitalia (excluding median lobe or siphon), dorsal aspect, of North American *Hippodamia* species. (Fig. B6 from Brown and de Ruette, 1962; remaining figures from Chapin, 1946). — B1, *H. tredecimpunctata* (L.); BP—basal piece; BL—basal lobe; PA—paramere; VA—ventral ala. B2, *H. americana* Crotch. B3, *H. falcigera* Crotch. B4, *H. washingtoni* Timberlake. B5, *H. parenthesis* (Say). B6, *H. arctica* (Schneider), basal lobe only. B7, *H. apicalis* Casey. B8, *H. lunatamaculata* Motschulsky. B9, *H. quinquesignata* (Kirby). B10, *H. glacialis* (Fab.). B11, *H. moesta* LeConte. B12, *H. convergens* Guérin Ménéville. B13, *H. caseyi* Johnson. B14, *H. oregonensis* Crotch. B15, *H. sinuata* Mulsant.

Distribution. — Arctic and subarctic North America, Fig. 146. Recorded from: Alaska, northern British Columbia, northern Ontario, Northwest Territories, and Yukon. Also recorded from Alberta, Mountain Park refugium (based on one elytron found under rocks).

Note on classification. — Although there is no compelling reason to maintain a separate genus for this species, nonetheless *H. ulkei* does not fit into any of the groups proposed by Chapin (1946). It seems best to include this species in a group of its own, diagnosed by characters in the key plus male genitalia with small ventral alae (see Watson, 1954, for an illustration of the ventral aspect of the genitalia).

Collecting and natural history notes. — Habitat: arctic, subarctic tundra, and alpine tundra in the northern Rocky Mountains.

Number of specimens examined. — 41.

Hippodamia tredecimpunctata (Linnaeus)

Coccinella 13-punctata Linnaeus, 1758:366. Type locality: "Europa." Type in BMNH, not studied.

Coccinella tibialis Say, 1824:94. Type locality: "Missouri." Type lost. Synonymized by Mulsant, 1850:10.

Comparison. — Distinguished from other North American *Hippodamia* species by: bicolor-ed legs, tibiae light brownish-yellow, femora black.

Description. — Habitus and maculation as in Fig. 70. Color: head black, frons with yellowish-white interocular mark; mouthparts and antennae light brownish-yellow; pronotum mostly black, except anterior and lateral margins yellowish-white; elytra red-orange, each with seven black spots; ventral surface and legs black; tibiae light brownish-yellow; mesepimera and metepimera yellowish-white. Male genitalia, as in Fig. B1. TL 5.2 - 6.2 mm; W 3.1 - 3.5 mm.

Distribution. — Holarctic Region. Widely ranging in North America, Fig. 161.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), grassland and parkland. Bionomics of this species was described by Cutright (1924).

Number of specimens examined. — 467.

Hippodamia americana Crotch

Hippodamia americana Crotch, 1873:368. Type locality: "Hudson Bay." Type not studied.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: size (TL 4.0-4.5 mm); distinctive elytral maculation (Fig. 56); unique male genital armature (Fig. B2); range in boreal North America (Fig. 148).

Description. — Habitus and maculation as in Fig. 56. Color: head black with yellowish-white interocular spot; mouthparts and antennae light brownish-yellow; pronotum mostly black, except anterior and lateral margins narrowly bordered whitish-yellow; elytra yellow-orange, maculation black, suture narrowly pigmented black; ventral surface and legs black; tarsi light brownish-yellow. Sculpture: dorsal surface distinctly punctate, shagreened. Male genitalia as in Fig. B2. TL 4.0 - 4.5 mm; W 2.3 - 2.5 mm.

Distribution. — Widely ranging in northern half of North America, Fig. 148. Recorded from: Alberta, British Columbia, Manitoba, Northwest Territories, Ontario, and Saskatchewan.

Collecting and natural history notes. — Habitat: boreal forest and parkland, on plants infested with aphids.

Number of specimens examined. — 31.

Hippodamia falcigera Crotch

Hippodamia falcigera Crotch, 1873:368. Type locality: "Slave Lake, Hudson's Bay." Type not studied.

Hippodamia sinuata albertana Casey, 1924:157. Type locality: "Edmonton, Alberta." Type in USNM. Synonymized by Chapin, 1946:7.

Ceratomegilla cottlei Nunenmacher, 1934:20. Type locality: "Yellowstone Park, Wyoming." Type in CAS. Synonymized by Chapin, 1946:7.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: size (TL 5.1-5.3 mm); unique elytral maculation (each elytron with longitudinal vitta, curved posteriorly); and geographic range confined to northwestern North America (Fig. 153).

Description. — Habitus and maculation as in Fig. 59. Color: head black; frons with median interocular yellowish-white spot; mouthparts and antennae light brownish-yellow; pronotum mostly black, anterior and lateral margins bordered yellow; elytra yellow, each maculate with longitudinal vitta, curved at posterior end; suture pigmented black, tapered posteriorly. Ventral surface and legs black; mesepimera and metepimera yellowish-white. Abdomen: metacoxal arcs obscured. Male genitalia as in Fig. B3: basal lobe broadly rounded apically, narrowly constricted at apex. TL 5.1 - 5.3 mm; W 3.0 - 3.2 mm.

Variation. — Specimens of this species do not appear to vary markedly in maculation or size. Chapin (1946:7) noted lack of pigmentation of pronotum in one specimen, and vittae of elytra divided into two parts in another.

Distribution. — Northwestern North America, Fig. 153. Recorded from: Alberta, British Columbia, Idaho, Northwest Territories, Wyoming, and Yukon.

Collecting and natural history notes. — Habitat: boreal forest and parkland, on plants infested with aphids.

Number of specimens examined. — 48.

Hippodamia washingtoni Timberlake

Hippodamia washingtoni Timberlake, 1939:265. Type locality: "Longmire Spring, Mount Rainier, Washington." Type in CAS, not studied.

Comparison. — Distinguished from other North American *Hippodamia* species by: general habitus and maculation (Fig. 69); size (TL 5.5-6.0 mm); geographic range confined to western coastal North America (Fig. 159).

Description. — Habitus and maculation as in Fig. 69. Color: head black with single yellowish-white interocular spot; mouthparts and antennae yellowish brown; postantennal process pale yellow; pronotum mostly black, anterior and lateral margins bordered yellowish-white; elytra orange-yellow, each elytron maculate with 6 black spots, arranged as in Fig. 55; ventral surface and legs black, mesepimera and metepimera black. Male genitalia as in Fig. B4: similar to those of *H. falcigera*, siphon with comparatively large dorsal flange near apex. In specimens of *H. falcigera* this projection is smaller than in *H. tredecimpunctata*. TL 5.2 - 6.0 mm; W 2.9 - 3.8 mm.

Variation. — Pigmentation of pronotum varied only slightly, holotype with mark similar to *H. tredecimpunctata*, disc with blunt lateral spur on each side. Elytral maculation varied considerably. This is the only species of the *tredecimpunctata* group of Chapin (1946) with individual specimens without black maculation. In maculate individuals, it appears to be characteristic for spots 0.5 and 3 to be coalescent with their counterparts to form an inverted T-shaped mark.

Distribution. — Pacific coast of North America, Fig. 159. Recorded from coastal British Columbia, Oregon and Washington.

Collecting and natural history notes. — Habitat: parkland and forest.

Number of specimens examined. — 3.

Hippodamia parenthesis (Say)

Coccinella parenthesis Say, 1824:93. Type locality: "United States." Type lost.

Coccinella tridens Kirby, 1837:299. Type locality: None specified. Type lost. Synonymized by Crotch, 1873.

Adonia parenthesis: Mulsant, 1850:40.

Comparison. — Distinguished from similar *H. lunatomaculata* by: structure of male genitalia (Fig. B5) and from *H. apicalis* by elytral maculation (subapical lunule not extended to apex).

Description. — Habitus and maculation as in Fig. 66. Color: head black, frons with three, yellowish-white interocular spots; in some specimens spots confluent; mouthparts and antennae light brownish-yellow; pronotum mostly black, except anterior and lateral margins yellowish-white; elytra orange-yellow, maculate with black; each elytron with humeral spot, discal spot, and subapical lunule; front sutural spot elongate; ventral surface and legs black, except mesepimera and metepimera yellowish-white. Elytra: apices distinctly pointed (aciculate); margins narrowly reflexed. Male genital as in Fig. B5. TL 4.5 - 5.1 mm; W 3.0 - 3.1 mm.

Distribution. — Widely ranging in North America, Fig. 156.

Collecting and natural history notes. — Habitat: grassland and parkland, on plants infested with aphids.

Number of specimens examined. — 450.

Hippodamia arctica (Schneider)

Coccinella arctica Schneider, 1792:148. Type locality: “?Lapland.” Type not studied.

Adonia arctica (Schneider): of authors. See note on synonymy under generic description.

Comparison. — Distinguished from other North American *Hippodamia* species by: small size (TL 3.0-3.8 mm); range in arctic, subarctic North America (Fig. 147); unique elytral maculation (Fig. 55), elytral suture bordered black. This species is a member of the *parenthesis* group of Chapin (1946).

Note. — Scott (1933) reported this species from Kirkman Creek, Yukon Territory; and Eagle, Alaska on the Yukon boundary as *Adonia amoena* Falderman - a Siberian species. As noted by Brown and de Ruelle (1962), these records are based on specimens of *H. arctica*. Furthermore, Mader (1926) expressed doubts that *H. amoena* and *H. arctica* are specifically distinct. Without specimens of *H. amoena* available for study, the status of this species cannot be decided at present time.

Description. — Habitus and maculation as in Fig. 55. Color: head black with two interocular, yellowish-white spots; antennae and mouthparts light brownish-yellow; pronotum mostly black, lateral and anterior margins bordered whitish-yellow; elytra mostly black, maculate with yellow vittae, pattern as in Fig. 55; ventral surface and legs black, except tarsi brown. Sculpture: dorsal surface distinctly punctate, shagreened, dull in appearance; punctures unequal, shallow. Elytra: margins narrowly reflexed. Abdomen: metacoxal arcs complete, distinctly impressed. Male genitalia as in Fig. B6: basal lobe stout, markedly constricted apically to form arrow head-like process. TL 3.0 - 3.8 mm; W 2.0 - 2.3 mm.

Distribution. — Arctic and subarctic North America, Fig. 147. Recorded from: Alaska, northern British Columbia, Labrador, northern and central Quebec, Northwest Territories, and Yukon.

Collecting and natural history notes. — Habitat: arctic and subarctic tundra, on plants infested with aphids.

Number of specimens examined. — 10.

Hippodamia apicalis Casey

Hippodamia apicalis Casey, 1899:81. Type locality: Reno, Nevada. Type in USNM.

Hippodamia parenthesis expurgata Casey, 1908:400. Type locality: Boulder Co., Colorado. Type in USNM. NEW SYNONYMY.

Hippodamia lengi Johnson, 1910:55. Type locality: San Diego, California. Type location unknown. Synonymized by Chapin, 1946:9.

Hippodamia lunatomaculata expurgata: Timberlake, 1919:166. Misidentification.

Hippodamia lunatmarginata expurgata: Korschefsky, 1932:342. Misidentification.

Hippodamia expurgata: Chapin, 1946:72. NEW SYNONYMY.

Adalia nigromaculata Nunenmacher, 1934:20. Type locality: “San Diego County, California.” Type in CAS. Synonymized by Chapin, 1946:9.

Hippodamia apicalis tricolor Nunenmacher, 1946:72. Type locality: “Lassen County, California.” Type in CAS, not studied. Synonymized by Hatch, 1962.

Note on synonymy. — Upon examination of type specimens in Casey’s collection (USNM) and large series of specimens from northwestern United States (Idaho, Utah), I consider *H. expurgata*: Chapin, 1946:72; (= *H. parenthesis expurgata* Casey) to be conspecific with *H. apicalis* Casey, based on continuous variation of apical portion of basal lobe of male genital armature.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: size (TL 3.5-4.5 mm); unique elytral maculation (subapical lunule extended

to apex); geographic range continued to western North America (Fig. 150).

Description. — Habitus and maculation as in Fig. 62. Body elongate oval, oblong. Color: head black, except crown-like yellowish-white interocular mark; mouthparts and antennae light brownish-yellow; pronotum mostly black, except anterior and lateral margins whitish-yellow; elytra yellow to yellow-orange, maculate with black spots, pattern as in Fig. 62; ventral surface and legs black, except reddish-light brown front tibiae and tarsi; mesepimera and metepimera white. Vestiture: frons sparsely, mouthparts and antennae more densely setose; dorsal surface of pronotum and elytra glabrous, elytral apex with several setae; ventral surface and legs setose. Sculpture: head and pronotum distinctly punctate, shagreened; elytra distinctly punctate, punctures large, unequal. Elytra: apex acuminate. Abdomen: metacoxal arcs complete, distinctly impressed. Male genitalia as in Fig. B7: apical portion of basal lobe varied from slender to broad triangle. TL 3.5 - 4.5 mm; W 2.0 - 3.0 mm.

Variation. — Maculation of elytra varied; spots reduced (southern Alberta). Subapical lunule confluent with humeral spot (some British Columbia and Washington specimens). *H. lengi* was described based on specimens with subapical lunule enlarged, extended to suture and confluent with scutellar spot (California).

Distribution. — Western North America, Fig. 150. Recorded from: Alaska, Alberta, Arizona, British Columbia, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, Saskatchewan, South Dakota, Utah, Washington, Wyoming and Yukon.

Collecting and natural history notes. — Habitat: sagebrush, Piñon-Juniper chaparral, xeric savannas and parkland. Collected on *Artemisia tridentata* infested with mites of *Bryobia* species.

Number of specimens examined. — 145.

Hippodamia lunatomaculata Motschulsky

Hippodamia lunatomaculata Motschulsky, 1845:382. Type locality: "vicinity of San Francisco Bay, California." Type not studied.

Hippodamia septemlunata: Dejean, 1836:456. *Nomen nudum*.

Hippodamia parenthesis: Casey, 1899:81. Misidentification.

Hippodamia lunatmarginata: Korschefsky, 1932:342. Unjustified emendation.

Hippodamia lunatomaculata dobzhanskyi Chapin, 1946:11. Type locality: "Port Angeles, Washington." Type in USNM, No. 57891.

Comparison. — Distinguished from very similar *H. parenthesis* by: details of male genital armature (Fig. B8) and range in coastal western North America. See the above key for further details.

Description. — Superficially indistinguishable from *H. parenthesis*. Male genitalia as in Fig. B8: basal lobe 0.25 longer than lateral lobes; apical 0.33 sharply constricted and produced into slender projection, terminated in bulbous apex. TL 4.4 - 5.2 mm; W 3.0 mm.

Variation. — Color and maculation: *H. lunatomaculata dobzhanskyi* was described from specimens with reduced pigmentation of pronotum, and marked enlargement of maculation on elytra (coastal Oregon and Washington, southernmost coastal British Columbia).

Distribution. — Pacific coast of North America. Recorded from: British Columbia, California, Oregon, and Washington.

Collecting and natural history notes. — Habitat: coastal chaparral, parkland, and cultivated fields.

Number of specimens examined. — 14.

Hippodamia quinquesignata (Kirby)

Coccinella quinquesignata Kirby, 1837:230. Type locality: "Lat. 65°." Type not studied.

Hemisphaerica quinquesignata: Hope, 1840:157.

Hippodamia mulsanti LeConte, 1852:131. Type locality: "Pic River, Lake Superior." Type in MCZ. Synonymized by Chapin, 1946:13.

Hippodamia ambigua LeConte, 1852:131. Type locality: "California and Oregon." Type in MCZ. Synonymized by Chapin, 1946:13.

Hippodamia punctulata LeConte, 1852:131. Type locality: "San Francisco, California." Type in MCZ, Synonymized by Chapin, 1946:13.

Hippodamia leporina Mulsant, 1856:135. Synonymized by Crotch, 1873:366.

Hippodamia obliqua Casey, 1899:79. Type locality: "Sonoma County, California." Type in USNM. Synonymized by Chapin, 1946:13.

Hippodamia subsimilis Casey, 1899:79. Type locality: "?California." Type in USNM. Synonymized by Chapin, 1946:13.

Hippodamia vernix Casey, 1899:79. Type locality: "Wyoming." Type in USNM. Synonymized by Chapin, 1946:13.

Hippodamia uteana Casey, 1908:397. Type locality: "Sevier Lake, Utah." Type in USNM. Synonymized by Chapin, 1946:13.

Comparison. — Distinguished from other North American *Hippodamia* species by: general habitus and maculation (Fig. 67); size (TL 5.0-5.6 mm); details of male genital armature (Fig. B9).

Description. — Habitus and maculation as in Fig. 67. Color: head black, frons with large, yellowish-white interocular mark; mouthparts and antennae light brownish-yellow; pronotum mostly black, anterior and lateral margins yellowish-white; elytra orange-red, maculate with black, each elytron with humeral and discal transverse band, subapical spot; ventral surface and legs black; mesepimera and metepimera white. Male genitalia as in Fig. B9. TL 5.0 - 5.6 mm; W 3.2 - 3.4 mm.

Variation. — Elytral maculation varied. Pigmentation in specimens from the Okanagan Valley reduced, individual specimens almost immaculate, except for small scutellar spot.

Distribution. — Widely ranging in North America, Fig. 157. Recorded from: Alaska, Alberta, Arizona, British Columbia, California, Colorado, Dakotas, Idaho, Manitoba, Michigan, Montana, New Mexico, Northwest Territories, Oregon, central Quebec, Saskatchewan, Utah, Washington, Wyoming and Yukon.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland. A.M. Harper observed overwintering aggregations of this species at several localities in southern Alberta. Beetles were found under *Arctostaphylos uva-ursi* (L.), ca. 3,000-5,000 individuals; under *Juniperus* ?sp., ca. 2,000 individuals. At Porcupine Hills, 20 miles west of Claresholm, a smaller aggregation under rock of about 100 individuals contained also several specimens of *H. caseyi*. (Personal communication, A.M. Harper).

Number of specimens examined. — 286.

Hippodamia glacialis (Fabricius)

Coccinella glacialis Fabricius, 1775:80. Type locality: "America boreali." Type not studied.

Hippodamia extensa Mulsant, 1850:17. Type locality: "Californie septentrionale." Type not studied. Synonymized by Chapin, 1946:16.

Hippodamia lecontei Mulsant, 1850:1010. Type locality: "Santa Fe de Bogota," = Santa Fe., New Mexico. Type not studied. Synonymized by Chapin, 1946:17.

Hippodamia hoppingi Nunenmacher, 1934:21. Type locality: "Mt. Stillman, Tulare County, California." Type in CAS. Synonymized by Chapin, 1946:17.

Hippodamia glacialis mackenziei Chapin, 1946:19. Type locality: "Inyo County, California." Type in USNM, No. 57892.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of: general habitus and maculation (Fig. 63); size (TL 5.9-7.0 mm); and transcontinental range in temperate North America (Fig. 155).

Description. — Habitus and maculation as in Fig. 63. Color: head black with white interocular spot; pronotum mostly black, narrowly bordered white, with two oblique white marks; elytra orange-red, maculate with black spots; subapical spot large, conspicuous; two postmedian spots large and obliquely coalescent; anterior spots absent. Male genitalia as in Fig. B10. TL 5.9 - 7.0 mm; W 3.7 - 4.7 mm.

Variation. — Larger and broader than most *Hippodamia* species. Specimens from eastern half of North America are characterized by frequent absence of spots 0.5, 1, and 2; in some specimens absence of spot 3, and confluence of spots 4 and 5. Pronotum in most specimens marked with yellowish-white oblique vittae. *H. extensa* was described based on specimens with spots 2, 4, 5, and 6 absent, and frequent confluence of spots 1/2, 1, and 3 to form basal transverse bar. Pronotal oblique mark obliterated (coastal California). *H. glacialis mackenziei* was described from melanic specimens from high elevations in mountains of eastern California. Spots 0.5, 1, 3, 4, 5, and 6 confluent to form butterfly-shaped spot covering about two-thirds of elytra. Spot 2 separate and distinct.

Distribution. — Widely ranging in North America, Fig. 155. Recorded from: Alabama, Alberta, Arizona, British Columbia, California, Colorado, Dakotas, Idaho, Illinois, Indiana, Manitoba, Michigan, Montana, New Mexico, Northwest Territories, Ontario, Oregon, Quebec, Saskatchewan, South Carolina, Utah, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland.

Number of specimens examined. — 66.

Hippodamia moesta LeConte

Hippodamia moesta LeConte, 1854:19. Type locality: "Prairie Paso, Oregon." Type not studied.

Hippodamia politissima Casey, 1899:80. Type locality: "Monterey Co., California." Type in USNM. Synonymized by Chapin, 1946:21.

Hippodamia bowditchi Johnson, 1910:45. Type locality: "St. Marie's, Idaho." Synonymized by Chapin, 1946:21.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: size (TL 4.1-6.0 mm); general habitus and maculation (Fig. 64). Similar to *H. quinquesignata*, from which specimens differ by yellow-orange color of elytra, generally larger spots.

Description. — Habitus and maculation as in Fig. 64. Color: head black, frons with median, interocular yellow spot; mouthparts and antennae light brown; labrum, ultimate article of maxillary palpus, dark brown; pronotum mostly black, anterior angles whitish-yellow; elytra yellow to yellowish orange, maculation black; ventral surface and legs black except mesepimera and metepimera yellowish-white. Abdomen: metacoxal arcs obscured. Male genitalia as in Fig. B11. TL 4.7 - 7.0 mm; W 2.8 - 4.0 mm.

Variation. — High degree of melanism observed in some specimens, maculation coalescent. *H. moesta* was described based on a specimen with elytra completely black, except small whitish spot at basal margin of each elytron. *H. politissima* was described from immaculate specimens from California. Typical maculate specimens were described as *H. bowditchi*, with the elytral pattern similar to that of *H. quinquesignata*.

Distribution. — Widely ranging in western North America, Fig. 151. Recorded from: Alberta, British Columbia, California, Colorado, Idaho, Manitoba, Montana, Oregon, Saskatchewan, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: grassland and parkland, on plants infested with aphids.

Number of specimens examined. — 58.

Hippodamia convergens Guérin-Ménéville

Hippodamia convergens Guérin-Ménéville, 1844:321. Type locality: "Mexico and California." Type not studied.

Hippodamia praticola Dejean, 1836:456. *Nomen nudum*.

Hippodamia modesta Melsheimer, 1847:178. Type locality: "Pennsylvania." Type not studied. Synonymized by Chapin, 1946:23.

Hippodamia convergens var. *obsoleta* Crotch, 1873:367. Type locality: None specified. Synonymized by Chapin, 1946:23.

Hippodamia juncta Casey, 1899:80. Type locality: "Sonoma County, California." Type in USNM. Synonymized by Chapin, 1946:22.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: V-shaped, yellowish-white mark on black disc of pronotum; and from species which also possess this character, by size (TL 5.5-7.0 mm), and elytral maculation.

Description. — Habitus and maculation as in Fig. 61. Color: head black, frons with interocular, yellowish-white mark; mouthparts and antennae light brownish-yellow; pronotum mostly black, except anterior and lateral margins yellowish-white, disc with two posteriorly convergent yellowish-white vittae; scutellum black; elytra orange-yellow, in most specimens maculate, each elytron with 7 brown-black spots (Fig. 61); ventral surface and legs brown-black. Male genitalia as in Fig. B12. TL 5.5 - 7.0 mm; W 4.0 - 5.0 mm.

Variation. — Variation in elytral maculation was studied by Kellogg and Bell (1904), and Yosida (1956). Results of both studies indicate that approximately 86% of specimens had a full complement of six black spots on each elytron, 14% had some spots missing, 3.75% had more than 12 spots, and only 0.2% (Yosida, 1956) had some spots coalescent. It is noteworthy that eight specimens collected in Mexico (Hidalgo), have all elytral spots missing.

Distribution. — Nearctic Region, and Middle America, introduced to Cuba. This is the commonest and most widespread species of *Hippodamia* in North America, Fig. 152.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), chaparral, grassland and parkland. Hawkes (1926) reported aggregations of this species from Yosemite Valley, California.

Number of specimens examined. — 890.

Hippodamia caseyi Johnson

Hippodamia convergens caseyi Johnson, 1910: 21, 33. Type locality: "Fairfield, Washington." Type not studied.

Comparison. — Distinguished from other North American *Hippodamia* species by: larger size (5.5 mm); details of male genital armature (Fig. B13); and unique elytral maculation (Fig. 60).

Description. — Habitus and maculation as in Fig. 60. Color: head black with yellowish-white interocular band; mouthparts and antennae yellowish-brown; pronotum mostly black with anterior margin and both anterior and posterior angles yellowish-white, black discal area with two convergent yellowish-white vittae; mesepimera and metepimera white; elytra orange-yellow with black maculation; each elytron with humeral, large postscutellar, small marginal, transverse discal and subapical spot; ventral surface and legs black except tarsi brown-black. Sculpture: head and pronotum finely punctate, shagreened; elytra more coarsely punctate, shagreened. Abdomen: metacoxal arcs complete, distinctly impressed. Male genitalia as in Fig. B13. TL 5.5 mm; W 2.9 - 3.2 mm.

Distribution. — Western North America, Fig. 149. Recorded from: Alberta, British Columbia, Colorado, Idaho, Montana, Oregon, Utah, and Washington.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), parkland. Fields and McMullen (1972) reported overwintering aggregations in central British Columbia, e.g., from Apex Mt. (2,248 m), Baldy Mt. (2,303 m), Beaconsfield Mt. (2,196 m), Mt. Kobau (1,975 m), and Sheep Rock (2,200m). Aggregation sites were on south facing upper-most slopes of the mountains, among fractured boulders covered with lichens. The movement upward to aggregation sites from lower valleys was gradual, from early September to mid-October when these sites were covered by snow.

Number of specimens examined. — 142.

Hippodamia oregonensis Crotch

Hippodamia oregonensis Crotch, 1873:367. Type locality: "Oregon." Type not studied.

Hippodamia dispar Casey, 1899:79. Type locality: "Colorado." Type in USNM. Synonymized by Chapin, 1946:24.

Hippodamia puncticollis Casey, 1899:78. Type locality: "Canadian Rocky Mountains." Type in USNM. Synonymized by Chapin, 1946:24.

Hippodamia lilliputana Casey, 1908:397. Type locality: "Colorado." Type in USNM. Synonymized by Chapin, 1946:25.

Hippodamia cockerelli Johnson, 1910:49. Type locality: "Sangre de Cristo Range, Saguache Co., Colorado." Type not studied. Synonymized by Chapin, 1946:25.

Comparison. — Distinguished from other North American *Hippodamia* species by combination of characters: small size (TL 3.5-5.0 mm); unique elytral maculation (frontispiece); range in alpine, subalpine zone of Rocky Mountains (Fig. 154).

Description. — Habitus and maculation as in Fig. 65, frontispiece. Color: head black with yellow median diamond-shaped spot; pronotum mostly black, anterior angles, lateral and anterior margin narrowly yellow; elytra red-orange, each elytron maculate with transverse humeral band, median lunate spot, and oval apical spot; ventral surface and legs black, except mesepimera and metepimera white. Male genitalia as in Fig. B14. TL 3.5 - 5.0 mm; W 2.5 - 3.0 mm.

Variation. — Maculation: Size and shape of elytral spots varied. *H. lilliputana* was described based on specimens with reduced elytral spots, while *H. cockerelli* was described from a specimen with confluent elytral maculation (Colorado). Johnson (1910) reported two other specimens from Wyoming.

Distribution. — High elevations in the Rocky Mountains, Fig. 154. Recorded from: Alberta, British Columbia, Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming.

Collecting and natural history notes. — Habitat: alpine meadows, specimens seen crawling on rocks and low vegetation. Immediately south of study area; in Montana, I collected a number of pupae attached to rocks at elevation 6,660 ft (2,028 m) at Logan Pass, from which beetles emerged 22.VIII. Fields and McMullen (1972) reported overwintering aggregation sites in central British Columbia, e.g., from Apex Mt. (2,248 m), Mt. Baldy (2,303 m) and Beaconsfield Mt. (2,196 m). Aggregation sites were on the upper most slopes of these mountains, beneath rock slabs partially buried and with grasses and sedges growing around. These sites were situated so that exposure to wind resulted in shallow snow pack. In western Washington,

Edwards (1957) described aggregations near the summits of Pinnacle Peak (June) and Yakima Peak (September). Chapman (1954) reported aggregations of this species near the summits of several mountains in western Montana.

Number of specimens examined. — 79.

Hippodamia sinuata Mulsant

Hippodamia sinuata Mulsant, 1850:1011. Type locality: "California." Type not studied.

Hippodamia spuria LeConte, 1861:358. Type locality: "Oregon." Type in MCZ, not studied. Synonymized by Chapin, 1946:27.

Hippodamia trivittata Casey, 1899:81. Type locality: "Sonoma County, California." Type in USNM. Synonymized by Chapin, 1946:27.

Hippodamia crotchii Casey, 1899:80. Type locality: "Lake County, California." Type in USNM. Synonymized by Chapin, 1946:27.

Hippodamia complex Casey, 1899:80. Type locality: "Vancouver Island." Type in USNM. Synonymized by Chapin, 1946:27.

Description. — Habitus and maculation as in Fig. 68. Color: head black, frons with yellowish-white, interocular mark; antennae and mouthparts light brownish-yellow; pronotum mostly black, except anterior and lateral margins yellowish-white; elytra orange-yellow, maculate with black spots; ventral surface and legs black; Abdomen: metacoxal arcs obscured. Male genitalia as in Fig. B15. TL 4.9 - 5.1 mm; W 2.7 - 3.2 mm.

Distribution. — Widely ranging in western North America, Fig. 158 (only western distribution shown). Recorded from: Alberta, Arizona, British Columbia, California, Colorado, Idaho, Kansas, Manitoba, Montana, Oregon, Saskatchewan, Washington, Wyoming, and Yukon.

Collecting and natural history notes. — Habitat: cultivated fields (alfalfa), grassland and parkland, on plants infested with aphids. On Vancouver Island, D.H. Kavanaugh collected a large number of specimens by shaking out moss mats in late October.

Number of specimens examined. — 124.

Genus *Macronaemia* Casey

Macronaemia Casey, 1899:76. Type-species: *Coccinella episcopalis* Kirby, 1837:228, 309. Fixed by monotypy.

Micronaemia: Weise, 1905:218. Misspelling.

Comparison. — Distinguished from *Anisosticta* Chevrolat by more elongate body, maculation of elytra and details of male genital armature.

Description. — Coccinellini of small size (TL 3.0 - 4.0 mm). Body elongate. Color: head black, except frons anteriorly yellow, pronotum and elytra yellow, maculation black; ventral surface generally black, except legs light-brownish yellow. Head: eyes emarginate, coarsely faceted; antennae moderately long, each of 11 articles, clavate; maxillary palpus securiform; mandibles bifid at apex. Thorax: pronotum convex, transverse rectangle; recessed above eyes. Elytra: margins narrowly reflexed, beaded. Legs: tarsal formula 4-4-4, claws appendiculate.

Distribution. — North America, genus with single species only.

Macronaemia episcopalis (Kirby)

Coccinella episcopalis Kirby, 1837:228, 309. Type locality: "Canada". Type in BMNH, not studied.

Comparison. — Distinguished from *Anisosticta bitriangularis* and *A. borealis* by more elongate body, elytral maculation (Fig. 74) and details of male genital armature.

Description. — Habitus and maculation as in Fig. 74. Color: head black; frons yellow-white; mouthparts and antennae brownish-yellow; pronotum and elytra mostly yellow; maculation black, each elytron with longitudinal, discal vitta; suture narrowly pigmented black; ventral surface brown-black, except legs light brownish-yellow; prosternum, meso- and metepimera white. TL 3.5 - 4.3 mm; W 1.8 mm.

Distribution. — Widely ranging in western North America, Fig. 160. Recorded from: Alaska, Alberta, British Columbia, California, Colorado, Idaho, Iowa, Kansas, Manitoba, Minnesota, Montana, Northwest Territories, Ontario, Oregon, Saskatchewan, Washington, Wisconsin,

Wyoming, and Yukon.

Collecting and natural history notes. — Habitat: parkland, boreal forest, and cultivated fields.

Number of specimens examined. — 128.

Genus *Mulsantina* Weise

Mulsantina Weise, 1906:34. Replacement name for *Cleis* Mulsant, 1850:162, 208. Not Mulsant, 1850:132, 135. Type-species: *Cleis mirifica* Mulsant, 1850:209. (= *Cleis lynx* Mulsant, 1850:210). Subsequently designated by Crotch, 1874:142.

Pseudocleis Casey, 1908:406. Type-species: *Coccinella picta* Randall, 1838b:51. Originally designated. Synonymized by Timberlake, 1943:19.

Note on nomenclature and synonymy. — *Cleis* Mulsant, 1850:162, 208 is a junior homonym of both *Cleis* Mulsant, 1850, 132, 135; and *Cleis* Guérin-Ménéville (Lepidoptera). *C. mirifica*, and *C. picta* are in my opinion congeneric taxa. Thus the name *Pseudocleis* is a junior synonym of the name *Mulsantina*. Timberlake (1943:19) reported that the male genitalia of *M. lynx* are identical with those of *M. mirifica*, thus supporting Crotch (1874:142), who was first to suggest that the two were not specifically distinct. Crotch (1874) chose to use the specific epithet *lynx* in preference to *mirifica* for this species, though the latter has page priority.

Comparison. — Distinguished from other North American Coccinellini by general habitus (Fig. 72, 73); white prosternum, mes- and metepimera, meso- and metabasisternum, metepipleura.

Description. — Coccinellini of medium size (3.5 - 5.0 mm). Body oval, oblong. Head: eyes emarginate, finely faceted; antennae each of 11 articles, moderately long, clavate; mandibles bifid at apex; maxillary palpus securiform. Thorax: pronotum recessed above eyes, narrowly explanate laterally; elytra with lateral margins narrowly reflexed; legs normal, tarsal formula 4-4-4, claws appendiculate. Abdomen: with six visible sterna; metacoxal arcs incomplete.

Distribution. — North and Middle America, West Indies. Blackwelder (1945) listed five species included in this genus.

Key to adults of the species of *Mulsantina* from western Canada and Alaska

- 1 (0) Elytral suture narrowly brown-black *M. hudsonica* Casey, p. 351
- 1' Elytral suture not brown-black, or if brown-black, then as part of discal mark extended to suture *M. picta* (Randall), p. 350

Mulsantina picta (Randall)

Coccinella picta Randall, 1838b:51. Type locality: "Massachusetts." Type not studied.

Coccinella concinnata Melsheimer, 1847:177. Type locality: "Pennsylvania." Type lost. Synonymized by LeConte, 1850:238.

Harmonia contexta Mulsant, 1850:87. Type locality: "Mexique." Type not studied. Synonymized by LeConte, 1858:87.

Cleis minor Casey, 1899:95. Type locality: "Alameda and Siskiyou Co., California." Type in USNM. Synonymized by Leng, 1903:205.

Comparison. — Distinguished from other North American *Mulsantina* species by: general habitus and maculation (Fig. 73) and details of male genital armature.

Description. — Habitus and maculation as in Fig. 73. Color: Ventral surface mostly ivory-yellow, except for brown-black maculation; head black with three interocular yellow spots, in some individuals confluent; antennae and mouthparts yellow-brown; pronotum with M-shaped black disjointed mark; prosternum, mesepimera and metepimera ivory-yellow; legs yellow-brown; elytra mostly ivory-yellow, brown-black mark on each elytron with longitudinal vitta extended in U-shape to suture, and small marginal spot at 0.60. Vestiture: normal for genus. Sculpture: head and thorax distinctly but finely punctate, shagreened; elytra prominently punctate, punctures unequal. Legs: tarsal claws with prominent basal, quadrate tooth. TL 3.3 - 5.0 mm; W 3.0 - 3.5 mm.

Variation. — Color: pigmentation of pronotum and elytra varied, from indistinctly maculate to melanic, predominantly black variants, with many intermediates. Johnson (1910:72) reported melanic variation to be continuous. *C. concinnata*

was described based on a specimen with predominantly black elytra. *H. contexta* was described based on a specimen with elytral basal band continued from longitudinal discal vitta to suture. *C. minor* was described based on a specimen with posterior lateral spot at 0.60 confluent with longitudinal vitta, and extended to margin.

Distribution. — Widely ranging in North America, Fig. 162. Recorded from: Alabama, Alberta, British Columbia, California, Colorado, Idaho, Illinois, Indiana, Kansas, Montana, New York, Ontario, Oregon, Pennsylvania, Saskatchewan, Utah, Washington, and Wyoming.

Number of specimens examined. — 164.

Mulsantina hudsonica (Casey)

Cleis hudsonica Casey, 1899:96. Type locality: "Hudson Bay." Type in USNM.

Comparison. — Distinguished from other North American *Mulsantina* species by unique elytra pattern (Fig. 72).

Description. — Habitus and maculation as in Fig. 72. Color: head yellow, vertex black; antennae and mouthparts light brownish-yellow; pronotum mostly yellow with black maculation, pattern (Fig. 72). Elytra yellow, maculate with black spots and vittae; each elytron with longitudinal discal vitta and black spot on each side; suture narrowly pigmented black; ventral surface and legs light brown to black, except prosternum, basisternum, and epimera white. Sculpture: dorsal surface distinctly punctate, elytra without isodiametric meshes between punctures, shiny. Abdomen: metacoxal arcs incomplete. TL 4.0 - 4.5 mm; W 3.0 mm.

Variation. — Color: extent of pigmentation of head, pronotum, and elytra varied; elytral spots fused to form longitudinal vitta in some specimens.

Distribution. — Widely ranging in northern half of North America, Fig. 163. Recorded from: Alaska, Alberta, northern British Columbia, northern Manitoba, Northwest Territories, northern Ontario, northern Quebec, northern Saskatchewan, and Yukon.

Collecting and natural history notes. — Habitat: parkland and forest.

Number of specimens examined. — 64.

Genus *Anisosticta* Dejean

Anisosticta Dejean, 1836:456. Type-species: *Coccinella 19-punctata* Linnaeus, 1758:366. (= *C. 19-punctata* Fabricius, 1775.). Subsequently designated by Crotch, 1874:93.

Derivation of name. — From Greek, *aniso* + *sticta* = unequal + spots, in reference to maculation. First used by Dejean (1836), who credited its origin to Chevrolat. The name is often mistakenly attributed to Duponchel (1841, *In d'Orbigny*) who was the first to publish it with description of the genus.

Comparison. — Distinguished from other North American Coccinellini by combination, middle and hind tibiae with single spur each, tarsal claws simple, general habitus and maculation (Fig. 75).

Description. — Coccinellini of medium size (3.0 - 4.0 mm). Body elongate oval, oblong. Color: dorsal surface mostly yellow, maculation of pronotum and elytra brown-black; ventral surface brown-black except, legs light brownish-yellow, prosternum white. Vestiture: dorsal surface glabrous except, frons setose; ventral surface and legs setose. Sculpture: head punctate, shagreened; pronotum punctate, shagreened; elytra coarsely punctate, without isodiametric meshes, surface shiny. Head: subquadrate, eyes finely faceted, emarginate; antennae moderately long, each of 11 articles, clavate; maxillary palpus securiform. Elytra: lateral margins narrowly reflexed. Legs: tarsal formula 4-4-4, claws simple; middle and hind tibiae each with single spur. Abdomen: metacoxal arcs complete, semicircular, well impressed.

Distribution. — Holarctic Region with five species described. Two species recorded from North America.

Natural history. — Both larvae and adults are predaceous on aphids.

Systematic studies. — The North American species of this genus have been studied by Brown and de Ruette (1962), Casey (1899), Leng (1903). Bielawski (1958) revised this genus for the world (Palearctic region). Sasaji (1971) redescribed the single Japanese species.

Key to adults of the species of *Anisosticta* from western Canada and Alaska

- 1 (0) Elytral suture pigmented black, maculation confluent; arctic - subarctic North America *A. borealis* Timberlake, p. 352
- 1' Elytral suture black only at anterior 0.20; widely ranging in North America *A. bitriangularis* (Say), p. 352

Anisosticta bitriangularis (Say)

Coccinella bitriangularis Say, 1824:296. Type locality: "Northwest Territory." Type lost.

Coccinella multiguttata Randall, 1838b:51. Type locality: "Cambridge, Massachusetts." Type lost. Synonymized by LeConte, 1883:197.

Anisosticta strigata: Crotch, 1873:369. Misidentification.

Description. — Habitus and maculation as in Fig. 75. Color: head whitish-yellow, vertex black; mouthparts and antennae yellowish-brown; pronotum and elytra whitish-yellow, maculate with black spots; ventral surface black, except legs brownish-yellow, lateral margins of sterna yellowish-white. Vestiture: normal for genus. Sculpture: head punctate, shagreened; pronotum punctate, distinctly shagreened. Elytra: lateral margins distinctly reflexed. Legs: normal for genus. TL 3.3 - 4.0 mm; W 2.0 - 2.2 mm.

Distribution. — Widely ranging in North America, Fig. 164. Recorded from: Alaska, Alberta, British Columbia, California, Idaho, Manitoba, Michigan, Minnesota, Montana, North Dakota, Northwest Territories, Ontario, Oregon, Quebec, Saskatchewan, South Dakota, Washington, and Yukon.

Collecting and natural history notes. — Habitat: collected throughout the study area in marshes and other wet habitats. Treading was most successful technique in these situations.

Number of specimens examined. — 210.

Anisosticta borealis Timberlake

Anisosticta borealis Timberlake, 1943:45. Type locality: "Nulato, Alaska." Type in USNM.

Description. — Habitus and maculation as in Fig. 76. Color: head black, frons yellow anteriorly; mouthparts and antennae light brownish-yellow; pronotum and elytra yellow, maculate with black spots, pattern as in Fig. 76; each elytron with spots confluent longitudinally; ventral surface black, except legs light brownish-yellow; prosternum and metepimera whitish-yellow. Legs: tarsal claws simple, enlarged at base. TL 3.0 - 3.5 mm; W 2.1 - 2.2 mm.

Distribution. — Arctic and subarctic North America, Fig. 165. Recorded from: Alaska, northern Manitoba, Northwest Territories, northern Quebec, and Yukon.

Collecting and natural history notes. — Habitat: collected in northern regions, from pitfall traps or by hand on vegetation.

Number of specimens examined. — 87.

Genus *Psyllobora* Dejean

Psyllobora Dejean, 1836:458. Type-species: *Coccinella lineola* Fabricius, 1792:283. Subsequently designated by Timberlake, 1943:41.

Note on type species. — The designation of *Coccinella 20-maculata* Say, 1824:96; by Crotch (1874:135) is invalid. This species was not among those originally included.

Derivation of name. — From Greek, *psyllo* + *bora* = psyllid + eater, in reference to feeding habit. First used by Dejean (1836), who credited its origin to Chevrolat.

Comparison. — Distinguished from other North American Coccinellidae by combination of characters: small size (largest 3.0 mm), color mostly yellowish-white, maculate with black spots (Fig. 77, 78).

Description. — Body broadly oval, prominently convex, glabrous. Color: from ivory-yellow to whitish-yellow and yellow, maculate with brown-black spots. Head: antennae each of 11 articles; terminal article of maxillary palpus securiform, that of labial palpus globose; mandibles with row of 3 to 9 teeth along cutting edge, and at apex. Abdomen: with six visible

sterna; metacoxal arcs incomplete. Legs: normal, moderately long; tibiae simple, slender, tibial spurs absent; tarsal formula 4-4-4, claws each with quadrate basal tooth. Male genital armature (figured by Hatch, 1962): basal lobe symmetrical, longer than lateral lobes, apex produced into recurved blunt point; siphon with well developed basal capsule. Female genitalia (figured by Chapin, 1965): spermatheca arcuate cylinder; infundibulum present in most species, sperm duct relatively short.

Distribution. — Western Hemisphere, genus with more than 50 species included. Widely ranging in North America, with six species recorded.

Natural history. — Davidson (1921) reported *Psyllobora taedata* LeConte to feed on fungi of mildew type, e.g., *Sphaerotheca pannosa*, *Podosphaera clandestina*.

Key to adults of the species of *Psyllobora* from western Canada and Alaska

- 1 (0) Elytral distinctly punctate; punctures unequal, coalescent. Male genitalia: basal lobe only slightly longer than lateral lobes, gradually tapered to blunt point, and slightly recurved apically; siphon relatively stout for basal 0.20, very slender for remainder of its length *P. vigintimaculata* (Say), p. 353
- 1' Elytra indistinctly punctate; punctures fine, well separated. Surface polished. Body markedly convex. Male genitalia: basal lobe distinctly longer than lateral lobes, markedly constricted and recurved apically; siphon relatively uniform in diameter, narrowed only at apex *P. borealis* Casey, p. 353

Psyllobora vigintimaculata (Say)

Coccinella 20-maculata Say, 1824:96. Type locality: "Missouri." Type lost.

Psyllobora 20-maculata taedata LeConte, 1857:70. Type locality: "California." Type not studied.

Comparison. — Distinguished from other *Psyllobora* species known from western Canada and Alaska by combination of characters: transcontinental range; unique pronotal and elytral maculation (Fig. 77); and characters outlined in the above key.

Description. — Habitus and maculation as in Fig. 77. Color: head pale yellow, vertex with two black spots; mouthparts and antennae pale yellow; pronotum and elytra pale yellow; maculate with brown-black spots, pattern as in Fig. 77; ventral surface light brown, except legs pale yellow, and metabasisternum brown-black, metepimera whitish-yellow. Sculpture: dorsal surface distinctly punctate, punctures large, unequal, coalescent. Abdomen: metacoxal arcs incomplete. TL 1.9 - 2.7 mm; W 1.6 - 2.0 mm.

Variation. — Elytral maculation pattern varied, in some specimens, spots coalescent (Fig. 77).

Distribution. — Widely ranging in North America, Fig. 166.

Collecting and natural history notes. — Habitat: orchards, parkland, and forest. Both larvae and adults feed on mildews (Weed, 1889; Davidson, 1921).

Number of specimens examined. — 380.

Psyllobora borealis Casey

Psyllobora borealis Casey, 1899:102. Type locality: "Coeur d'Alene, Idaho." Type in USNM.

Comparison. — Distinguished from other *Psyllobora* species from western Canada and Alaska by: unique pronotal and elytral maculation (Fig. 78); larger size than *P. vigintimaculata*, and restricted range to the west of the Continental Divide (Fig. 167).

Description. — Habitus and maculation as in Fig. 78. Color: head pale yellow, frons with two black spots; mouthparts and antennae pale yellow; pronotum and elytra ivory-yellow, maculate with brown-black spots, pattern as in Fig. 78; ventral surface brown, except legs pale-yellow, mesepimera, metepimera yellowish-white. Vestiture: normal for genus. Sculpture: dorsal surface distinctly punctate, elytral punctures small, well separated. Legs: normal for genus. Abdomen: metacoxal arcs incomplete. TL 2.7 - 3.0 mm; W 2.0 mm.

Distribution. — Western North America, Fig. 167. Recorded from: British Columbia, Idaho, Colorado, Montana, Oregon, Utah, and Washington.

Collecting notes. — Habitat: parkland, (orchards), forests.

Number of specimens examined. — 123.

ZOOGEOGRAPHY

Introduction

The composition of the coccinellid fauna of western Canada and Alaska and peculiarities in geographic distribution of its taxa are end results of the evolutionary history of this group. In the following, I attempt: (1) to elucidate the post-glacial origin of this fauna, particularly in reference to Pleistocene glaciations; (2) to evaluate the significance of the Rocky Mountains as a dispersal barrier, and (3) to evaluate the effectiveness of refugia as centres of post-glacial dispersal. Furthermore, I speculate about the origin and affinities of this fauna in general. I hope that these hypotheses and conclusions provide some answers to questions about the origin and history not only of the coccinellid portion of the fauna of western North America, but also other animal groups.

Distribution patterns of Coccinellidae in western North America

There have been many attempts to formally describe biotic provinces or regions for North America (Dice, 1943, 1952; Hagmeier, 1966; Van Dyke, 1919, 1926). The life zone concept, originally proposed by Merriam (1892, 1894, 1898) on the basis of temperature, has been declared unsatisfactory by Kendeigh (1932), Shelford (1932), and others. However, it is possible and useful to describe *life zones*, e.g., forest regions of Canada (Rowe, 1972), in reference to dominant tree species, or alpine zone in reference to altitude; but these concepts are fundamentally different from biotic provinces as areas with more or less uniform composition or biota. Recent studies (Kaiser *et al.*, 1972) indicate that the basic premise of attempts to define biotic provinces is fallacious. The basic difference between biotic province and life zone is that the first is based on composition of the faunal/floral assemblage in a given area, whereas the life zone concept is basically ecological, i.e., different places have different habitat conditions (climatic, edaphic). As pointed out by Muesebeck and Krombein (1952), "sufficient data have been analyzed so that the range of many species may be given succinctly by reference to life zones." The map (Fig. 169), Life zones of North America, summarizes the present delineation of life zones. Here I recognize seven major zones: (AA) Arctic-Alpine; (H) Hudsonian; (C) Canadian; (T) Transition; (UA) Upper Austral; (LA) Lower Austral; (ST) Subtropical. The alpine zone in the Rocky Mountains could not be indicated on the map, because of the generally small size of these areas and the scale of this map. The subtropical zone is not considered in further discussion because the post-glacial origin of the fauna of British Columbia and Alberta was not effected by its extent, nor was species composition. The present distribution ranges of many species correlate to a high degree with the mentioned life zones, delineated by the general physiography of the continent (mountainous barriers) and climatic patterns combined with types of vegetation in a given zone.

Coccinellid fauna of western Canada and Alaska

Most of the area was glaciated during Wisconsin time (Fig. 168). There is general agreement that in glaciated areas the fauna was exterminated and/or displaced elsewhere, most species southward of the limits of glacial ice. Thus, it follows that the present coccinellid fauna of western Canada and Alaska is derived post-glacially from unglaciated source areas south or north of the ice-sheet, and from refugial areas (nunataks) in the Rocky Mountains. Therefore, the questions of interest center upon the environmental zonation (life zones), and changes since the Pleistocene glaciation, the geographic location of source areas, and the recolonization of glaciated areas during Wisconsin time. Problems of interpretation are complicated by the physiographically complex land surface of western Canada. Survival of biota in refugia during the Pleistocene glaciation is generally accepted. Lindroth (1969) discussed the biolo-

gical significance of such refugia, described them, and provided a historical account of the ideas which led to the development of concepts of biotic refugia during glacial periods. Furthermore, Lindroth (1965) demonstrated unexpectedly favorable conditions for survival of cold adapted biota in the immediate vicinity of glacial ice in coastal areas of Iceland. In North America, the most important and largest unglaciated area north of the continental ice-sheet, the Beringian refugium, covered most of Alaska and parts of the Yukon Territory (Fig. 168, area 1). Several authors (Matthews, 1968; 1974; 1975; Hopkins *et al.*, 1971) documented a rich insect fauna in Beringia during Wisconsin time.

Packer and Vitt (1974) reviewed the botanical evidence suggesting numerous refugia throughout the Northern Rocky Mountains and pointed to the area of Mountain Park in Alberta as one of the refugia. My investigation of this area tentatively supports their evidence, based on a find of one recent elytron of *Hippodamia ulkei*, an arctic-subarctic coccinellid. Another example of a disjunct relict is a carabid beetle *Amara alpina* Paykull. This latter species is presently restricted to the subarctic and arctic regions of North America, except for disjunct populations in refugia in the alpine zone of the Rocky Mountains. I believe that at least the highly vagile portion of the fauna of glaciated areas was not exterminated but rather was displaced (or moved) as the habitat became locally unavailable. Taxa adjust their distribution ranges according to the environmental conditions, often on a grand scale (Coope, 1970; 1972; 1973; and Coope & Angus 1975). This hypothesis is supported by disharmonious associations (faunal and floral assemblages with no extant counterparts), as reported in several palaeo-ecological studies (Hibbard *et al.*, 1965; Matthews, 1975). The effectiveness of refugia as centres of post-glacial dispersal of biota in the Rocky Mountains is becoming increasingly evident with every systematic study conducted in western Canada (Freitag, 1965; Larson, 1975; Nimmo, 1971). In British Columbia, the glaciation was thought to have been general, and the ice-sheet to have covered the mainland and coastal islands (Vancouver Island, Queen Charlotte Islands). Calder and Taylor (1968) concluded from botanical evidence that the Queen Charlotte Islands served as a refugium during the Pleistocene glaciation. The effectiveness of coastal refugia for the coccinellid portion of the fauna is not established. Elsewhere in the Pacific Northwest, the presence of refugia was suggested by Heusser (1960), with a major refugium south of the ice-sheet (Fig. 168, source area 3).

Life zones

The Arctic zone (Fig. 169AA) is characterized by treeless tundra. The coccinellid fauna of the arctic zone is markedly different from that of the forested zones to the south (Hudsonian and Canadian). The number of species recorded from this zone is relatively small (27), and affinities with the Palearctic Region are suggested by a high proportion of circumpolar species. A number of species are endemic to this zone, e.g., *Hippodamia ulkei*, (Fig. 146) and *H. arctica* (Fig. 147). The alpine zone in the Rocky Mountains is analogous in the environmental conditions with the Arctic zone. The fauna of the alpine zone of the Cordillera includes some species that are primarily restricted to the arctic zone, but this element represent relicts from glacial times when arctic-subarctic zone was more extensive. This suggests that the Rocky Mountains served as a corridor for cold adapted species to extend their ranges during glacial periods.

The Alpine zone (not indicated on Fig. 169) is inhabited by a number of alpine endemics, e.g., *Hyperaspis jasperensis*, *Hippodamia oregonensis*, *Coccinella alta*, none of which are found in the arctic zone. The wide range of some of these species in the alpine zone of Sierra Nevada and Rocky Mountains, and their absence from the arctic zone, suggest that dispersal is relatively easy (to account for presence of *C. alta* (Fig. 137) in the alpine zone of Sierra Nevada Mountains), and that factors other than climate control the distribution of alpine endemics. During the summer months the fauna of the alpine zone is enriched by influx of species from surround-

ing lowlands. The summer immigrants do not breed at high elevations.

The Hudsonian zone (Fig. 169H) is generally characterized by open, discontinuous coniferous forests with the ground covered by lichens. Hudson Bay effectively divides both the arctic and Hudsonian zone into two separate, discontinuous sectors (see Fig. 169). The eastern populations of *Hippodamia ulkei* from Cape Henrietta Maria are represented by non-melanic specimens, while the western specimens are invariably melanic. The Hudsonian zone in the Rocky Mountains contains a number of relict species, very probably of Beringian derivation e.g., *Hippodamia americana*, *H. falcigera*. The rest of the fauna consists of species derived from the Canadian zone.

The Transition zone (Fig. 169T) is extensively developed east of the Rocky Mountains, but is also present on the western side of the Rocky Mountains. The dominant vegetation of the eastern sector (east of the Rocky Mountains) is the deciduous forest, gradually replaced by parkland and prairie grasslands. West of the Rocky Mountains the zone is characterized by dominance of *Pinus ponderosa*. The effects of the Rocky Mountains on the composition of the fauna of this zone are very pronounced. The grassland-prairie portion is inhabited by a number of endemic species, e.g., *Hyperaspidius hercules*, *Chilocorus hexacyclus*. Similarly the western sector of the Transition zone (west of the Rocky Mountains) is inhabited by endemic species, e.g., *Hippodamia lunatomaculata*, *H. washingtoni*, *Coccinella californica*, *Psyllobora borealis*, and the introduced species *Coccinella undecimpunctata* and *Stethorus punctillum*. Either the Rocky Mountains are an effective dispersal barrier for species restricted to either sector of the Transition zone, or if it is assumed that dispersal is easy (as postulated in the following), the endemic faunal element of the Transition zone west of the Rocky Mountains is older than the Pleistocene. The glaciation of the Rocky Mountains during Wisconsin time only strengthened the division of already differentiated endemics in both the western and eastern sectors of the Transition zone. The boundary between the Canadian and the Transition zone is not markedly distinct, that between Transition and Upper Austral zones is distinct.

The Upper Austral zone (Fig. 169UA) is divided by the Rocky Mountains into western and eastern sectors. This parallels the situation analogous in the Transition zone. The eastern sector is not considered here, because this sector was not studied within the scope of this project. The western sector is characterized by oak-piñon-juniper chaparral, and often referred to as the Upper Sonoran region.

The Lower Austral zone (Fig. 169LA) is primarily developed in the southeastern United States. West of the Rocky Mountains, this zone occupies relatively small areas, characterized by semidesert, desert vegetation, e.g., *Larrea divaricata*, and several species of *Fouquieria*. It is referred to as Lower Sonoran region (a distinction based on the amount of precipitation).

The composition of the fauna of British Columbia and Alberta and the present distribution of species indicate that in terms of post-glacial origin and affinities, the present fauna was most probably derived from the following four source areas (Fig. 168, areas 1, 2, 3, 4): This conclusion is primarily derived from the present distribution ranges of species (Fig. 88-167), and based on several assumptions. These are: (1) species occupy the maximal range available to it at any given time (this implies easy dispersal); (2) ecological tolerances or requirements of the species did not change during the Pleistocene (cold adapted species are still cold adapted); (3) speciation on a large continental land mass is much slower than generally believed; and (4) glaciation as a process was gradual, and did not provide any new forces or habitats which may lead to speciation.

Source areas of post-glacial dispersal of Coccinellidae in western North America

Source area 1. — Beringian refugium and refugia throughout the Northern Rocky Mountains (ca. 3%). This element of the fauna is represented by cold-adapted, arctic-subarctic taxa,

e.g., *Hippodamia arctica*, *Hippodamia ulkei*, *Coccinella fulgida*, *Anisosticta borealis*. These species, I believe, occupied the arctic and subarctic regions before glaciation, and with gradual cooling of the environment during glacial periods, the suitable habitats expanded southward, mainly along ranges of the Rocky Mountains. That the above species followed the habitat seems very likely. Many of the invaders from the north became stranded in the alpine zone at numerous places in the Rocky Mountains.

Source area 2. — Cordilleran refugia which included numerous southern Rocky Mountain refugia (ca. 12%). This element is represented by montane and alpine taxa, e.g., *Hyperaspis jasperensis*, *Coccidula occidentalis*, *Calvia* (*Anisocalvia*) *quattuordecimguttata*, *Hippodamia americana*, *H. falcigera*, *H. oregonensis*, *H. washingtoni*, *Coccinella alta*. These species, I believe, survived the glaciation in nunatak areas throughout the Northern Rocky Mountains, and in alpine zone of the Southern Rocky Mountains, and Sierra Nevada Mountains.

Areas 3 - 4. — Areas south of the ice-sheet, where the pre-glacial displaced British Columbia-Albertan fauna survived, and from where the basically southern taxa subsequently dispersed northward. This element represents the majority of species now found in both provinces (ca. 85%).

Table I summarizes composition of the fauna of western Canada and Alaska in reference to probable areas of post-glacial origin, (Fig. 168, areas 1, 2, 3, 4), and lists the life zones presently occupied by species recorded. The Palaearctic species recently introduced to North America are indicated by an asterisk (*). The species known from small areas in size are indicated by a zero (0). It should be noted that some species survived the Pleistocene glaciation in several areas. This is suggested by geographic variation in color and pattern, or both, in several species. The color pattern variation is genetically determined, and thus geographically circumscribed variants imply genetic isolation. This can be explained by isolation of a population(s) from the main gene pool elsewhere, and implies that the Rocky Mountains effectively isolated several such populations during the Pleistocene glaciation on the west coast. For example, *Coccinella californica*, *C. trifasciata*, *C. novemnotata*, all show geographic variation, (in reduction of spots on elytra), generally restricted to the west coast. The possible influence of oceanic climate does not cause the same effects on the Atlantic coast. Table II provides a summary of a total number of Coccinellidae within the life zones in western North America, and a cross-reference to postulated source areas of post-glacial dispersal.

TABLE I
LIFE ZONES AND SOURCE AREAS OF POST-GLACIAL DISPERSAL
OF COCCINELLIDAE IN WESTERN NORTH AMERICA

Species:	Life zone:	Source areas:
<i>Coccinella fulgida</i>	AA H C	1 2
<i>Hippodamia ulkei</i>	AA H C	1 2
<i>Hippodamia arctica</i>	AA H C	1 2
<i>Hippodamia americana</i>	AA H C	1 2
<i>Hippodamia falcigera</i>	AA H C	1 2
<i>Mulsantina hudsonica</i>	H C	1 2
<i>Anisosticta borealis</i>	AA H C	1 2
<i>Hyperaspis jasperensis</i>	AA	2 0
<i>Anatis lecontei</i>	H T UA	2
<i>Coccinella alta</i>	AA H C	2
<i>Hippodamia oregonensis</i>	AA H C T	2
<i>Didion longulum</i>	H T UA	3

Table I (continued)

Species:	Life zone:	Source areas:
<i>Stethorus picipes</i>	T UA	3
<i>Scymnus (S.) phelpsi</i>	T UA	3
<i>Scymnus (S.) caurinus</i>	T UA	3
<i>Scymnus (P.) postpictus</i>	T UA	3
<i>Scymnus (P.) ardelio</i>	T UA	3
<i>Scymnus (P.) coniferarum</i>	T UA	3
<i>Scymnus (P.) marginicollis</i>	T UA	3
<i>Scymnus (P.) calaveras</i>	T UA	3
<i>Nephus georgei</i>	H C T	3
<i>Hyperaspidius arcuatus</i>	T UA	3
<i>Hyperaspis fastidiosa</i>	T UA	3
<i>Hyperaspis postica</i>	T UA	3
<i>Hyperaspis elliptica</i>	T UA	3
<i>Hyperaspis oregona</i>	T UA	3
<i>Hyperaspis simulatrix</i>	T UA	3
<i>Hyperaspis lanei</i>	T UA	3
<i>Hyperaspis dissoluta</i>	T UA	3
<i>Exochomus aethiops</i>	T UA	3
<i>Chilocorus tricyclus</i>	T UA	3 0
<i>Anatis rathvoni</i>	T UA	3
<i>Myzia subvittata</i>	T UA	3
<i>Myzia horni</i>	T UA	3
<i>Cycloneda polita</i>	T UA	3
<i>Coccinella californica</i>	C T	3
<i>Coccinella prolongata</i>	T UA	3
<i>Hippodamia caseyi</i>	T UA	3
<i>Hippodamia apicalis</i>	T	3
<i>Hippodamia moesta</i>	T UA	3
<i>Hippodamia lunatomaculata</i>	C T	3
<i>Hippodamia washingtoni</i>	T	3
<i>Psyllobora borealis</i>	C T	3
<i>Scymnus (P.) lacustris</i>	C T	3 4
<i>Coccidula occidentalis</i>	H C T	3 4
<i>Anatis borealis</i>	H C T	3 4
<i>Calvia quattuordecimguttata</i>	AA H C T	3 4
<i>Adalia bipunctata</i>	AA H C T UA	3 4
<i>Coccinella monticola</i>	AA H C T UA	3 4
<i>Coccinella transversoguttata</i>	AA H C T UA	3 4
<i>Coccinella hieroglyphica</i>	AA H C T UA	3 4
<i>Coccinella trifasciata</i>	AA H C T	3 4
<i>Microweisea marginata</i>	C T UA LA	4
<i>Microweisea misella</i>	C T UA LA	4
<i>Didion nanus</i>	T UA	4
<i>Didion punctatus</i>	T UA LA	4
<i>Scymnus (S.) apicanus</i>	T UA LA	4
<i>Scymnus (S.) paracanus</i>	T UA LA	4

Table I (continued)

Species:	Life zone:	Source areas:
<i>Scymnus (S.) opaculus</i>	T UA LA	4
<i>Nephus ornatus</i>	T UA	4
<i>Nephus sordidus</i>	T UA LA	4
<i>Hyperaspidius vittigerus</i>	T UA LA	4
<i>Hyperaspis lateralis</i>	T UA LA	4
<i>Hyperaspis fimbriolata</i>	T UA LA	4
<i>Hyperaspis quadrivittata</i>	T UA LA	4
<i>Hyperaspis undulata</i>	T UA LA	4
<i>Hyperaspis lugubris</i>	T UA LA	4
<i>Brachiacantha ursina</i>	T UA LA	4
<i>Chilocorus stigma</i>	T UA LA	4
<i>Brunoides septentrionis</i>	T UA LA	4
<i>Myzia pullata</i>	C T UA	4
<i>Olla v-nigrum</i>	T UA LA	4
<i>Coccinella novemnotata</i>	T UA LA	4
<i>Hippodamia convergens</i>	T UA LA	4
<i>Hippodamia glacialis</i>	T UA LA	4
<i>Hippodamia parenthesis</i>	T UA LA	4
<i>Hippodamia quinquesignata</i>	T UA LA	4
<i>Hippodamia sinuata</i>	T UA LA	4
<i>Macronaemia episcopalis</i>	T UA LA	4
<i>Hippodamia tredecimpunctata</i>	T UA LA	4
<i>Mulsantina picta</i>	T UA LA	4
<i>Anisosticta bitriangularis</i>	T UA LA	4
<i>Psyllobora vigintimaculata</i>	T UA LA	4
<i>Chilocorus hexacyclus</i>	T	4 0
<i>Scymnus (P.) carri</i>	T	4 0
<i>Hyperaspidius hercules</i>	T	4 0
<i>Scymnus (P.) aquilonarius</i>	T UA	4 0
<i>Stethorus punctillum*</i>	T	0
<i>Coccinella undecimpunctata*</i>	T UA	0

Summary of Table I

Totals:

Source areas (1) = 7; (2) = 11; (3) = 41; (4) = 44; (0) = 8;

Life zones: AA = 15; H = 20; C = 20; T = 80; UA = 66; LA = 28.

TABLE II
SUMMARY OF A NUMBER OF SPECIES OF COCCINELLIDAE WITHIN THE
LIFE ZONES IN WESTERN NORTH AMERICA

Source Areas	Life Zones					
	AA	H	C	T	UA	LA
1	6	7	7	—	—	—
2	9	11	9	2	1	—
3	6	10	13	41	30	—
4	6	8	12	44	36	28
0	—	—	—	7	3	—
Total	27	36	41	94	70	28

Transmontane relationships between British Columbia and Alberta

One of the aspects of analyses of transmontane relationships between the fauna of British Columbia and Alberta was to compare distribution across the Rocky Mountains of closely related species, to evaluate the effectiveness of mountainous barriers: (1) to dispersal; and (2) in reference to speciation, i.e., vicariance of species groups restricted to the west or east of the Rocky Mountain Trench.

Dispersal potential of coccinellids and vicariance. — It is necessary to consider the potential of coccinellids to disperse across barriers, e.g., large bodies of water, high mountain ranges, or vast areas of unsuitable habitats. In this respect, the power for dispersal of adults is exceedingly great. This ability is the result of strong flight muscles and functional wings. Adults of all species studied by me were found to possess fully developed functional wings. Coccinellids in general are good and habitual fliers. The best example to illustrate this power of dispersal that I can provide is that specimens of *Hippodamia convergens* were captured in flight on the top of Mount Evans in Colorado (elevation 14,600 ft).

Four major pathways through the Rocky Mountains could have been used for eastward movement of western species or *vice versa*. These are (Fig. 193): A - Upper Peace River pass; B - Yellowhead pass; C - Banff National Park Pass; D - Crowsnest Pass; and E - Waterton National Park Pass.

The Crowsnest Pass (D) appears to be the most important route for eastern species which have expanded their ranges westward, e.g., *Chilocorus* species. Distribution records of several species (Fig. 88-167) suggest that species with primarily western distribution, e.g., *Anatis rathvoni*, *A. lecontei*, *Myzia oregona*, *M. horni* (Fig. 127, 129-131) penetrate eastward only in a narrow corridor in southwestern Alberta, Waterton National Park area (Fig. 193E). From erratic distribution records, I assume that these are incidental, most probably wind-blown strays. Other records, e.g., a single specimen of *C. californica* from Alberta (Fig. 142), are most likely specimens transported by human activity. Wingo (1952) reported specimens of this species from Iowa and Missouri, and suggested that these were carried there with shipments of fruits and vegetables. Brown (1962) reported a single specimen from Oklahoma. The transport by human activity is the most plausible explanation for single records of adults

recorded far away from normal species range. No larvae were found at any of these localities.

The best documented example of vicariance is the species of the genus *Chilocorus* studied by Smith (1959, 1962, 1966). Smith (1966) studied hybridization between two sister-species, *C. tricyclus* (Saskatchewan, southern Alberta species), and *C. hexacyclus* (interior British Columbia species). *C. tricyclus* invaded *C. hexacyclus* territory through Crowsnest Pass (4,463 ft; 1361 m) borne on prevailing westerly winds. Both species hybridize in a narrow zone of the Crowsnest River valley (Fig. 193E). Smith (1966) estimated segregational sterility in this zone to be ca. 40%.

The vicariance between *Psyllobora borealis* and *P. vigintimaculata* is more difficult to evaluate because the two species are sympatric. Nonetheless, *P. borealis* is restricted to the west of the Rocky Mountains (Fig. 167), and *P. vigintimaculata* ranges widely in North America (Fig. 166). The two overlap in their distribution over the entire range of *P. borealis*. No introgression or hybridization was reported in the literature, and from my observations I am reluctant to suggest that it exists. The genus *Psyllobora* is most probably of Tertiary origin, suggested by the relatively high number of species included, and there is not any need to invoke the hypothesis that the Pleistocene glaciation has had anything to do with speciation in this primarily Middle American genus. In other genera, vicariance is not possible to evaluate, because relationships among species are not established.

The Rocky Mountains are not a significant dispersal barrier for species now isolated on either side of the Rocky Mountain Trench. A relatively large number of species range widely in North America, and the Rocky Mountains seem to have little effect on their distribution. From this I assume that, given the same potential for dispersal to all species, there are other factors involved, which prevent the western species to extend their distribution ranges eastward. This is clearly evident from the distribution maps (Fig. 88-167), a map of life zones (Fig. 169), and Tables I and II. For example, the Canadian, Hudsonian, or Transition zones, which are available on both sides of the Rocky Mountains, are occupied by some species restricted to only one side of the mountains. Some of these factors are ecological, but other (not understood by me) must be involved also. It is significant to note that the widely ranging species exhibit pronounced geographic variation in color, color pattern or both. The only passage where western species occasionally invade areas east of the Rockies is the Waterton National Park area (Fig. 193E). The particular combination of physiographic features in the Waterton National Park area results in a distinctive local climate. Waterton has the warmest winters in Alberta, the highest snow and rain precipitation. The effect of strong, southwesterly prevailing winds is most noticeable on trees. For the other mountain passes (Fig. 193A, B, C) there is no evidence to suggest that they have served as important dispersal routes between the fauna of Alberta and British Columbia. Penetration of eastern species into British Columbia territory is well documented (Smith, 1966) for several species, e.g., *Chilocorus tricyclus*, *C. hexacyclus* complex (Fig. 122-124). The fact that the ranges of these species are parapatric, and the two hybridize in the suture zone of contact, leads me to suggest that the differentiation process between *C. tricyclus*, and *C. hexacyclus* is not completed yet, and therefore of recent origin. Thus, species of this group are an exception to the general statement made earlier, and have evolved (differentiated) as a direct result of the Pleistocene glaciation.

Conclusions

1. — The coccinellid portion of the beetle fauna of western Canada and Alaska is represented by 88 recorded species. Twenty five species are recorded from Alaska, Yukon and Northwest Territories (north of 60° parallel). Sixty four species are recorded from Alberta, and 75 from British Columbia (87 including species not studied, but reliably recorded from southern British Columbia). Of these, nine species represent the Palearctic element of the fauna (introduced or circumpolar Holarctic species). Three species are recorded as arctic-subarctic en-

demic species, known from northern North America only. Four species, recorded as alpine endemics, are restricted to the alpine zone of the Rocky Mountains. Thirty five species are restricted to the west of the Rocky Mountains. Only five species are recorded as endemic to the prairie/grassland region, southeast of the Rocky Mountains. The remaining species range widely in North America, and in some instances also Middle and South America. The majority of widely ranging species are polymorphic, with pronounced geographic variation in color, maculation pattern, or both. Based on the above composition of this fauna, and assuming much slower evolutionary rates than generally believed, I postulate that the present coccinellid fauna of western Canada and Alaska is most probably derived post-glacially from the North American Tertiary fauna. This is suggested by a pronounced continental endemism at the species level; of the 88 species recorded, 75 (84.4%) are strictly North American species. At generic level, the affinity of the North American fauna is primarily with the Palaearctic Region. More than 71% genus-group taxa are common to the Holarctic Region.

2. — The post-glacial source areas (Fig. 168), from which the present fauna is derived, are postulated to be from areas south of the southern limits of glaciation (ca. 85%), with minor refugial elements which survived glaciation *in situ*, i.e., Cordilleran, Rocky Mountains refugia (ca. 12%), and the Beringian refugium (ca. 3%).

3. — The Rocky Mountains are not an effective barrier to dispersal of coccinellids. The adults of all species studied possessed fully developed functional wings, and coccinellids are generally strong and habitual fliers, capable to disperse by flight over the highest peaks of the Rocky Mountains. The endemism of some species restricted to areas on either side of the Rocky Mountains is most probably controlled by ecological and other factors. This hypothesis is supported by the inability of species to establish breeding populations when transported across the mountains with shipments of fruits and vegetables. The Rocky Mountains played a significant role in the development of the North American coccinellid fauna, mainly as a source of new habitats. The new habitats were created not only with the orogenesis of the Rocky Mountains themselves, but also as a result of altered weather patterns in most of the western North America. The influence of the Pleistocene glaciation on the composition of the coccinellid fauna was relatively insignificant. The effects of glaciation on distribution were profound.

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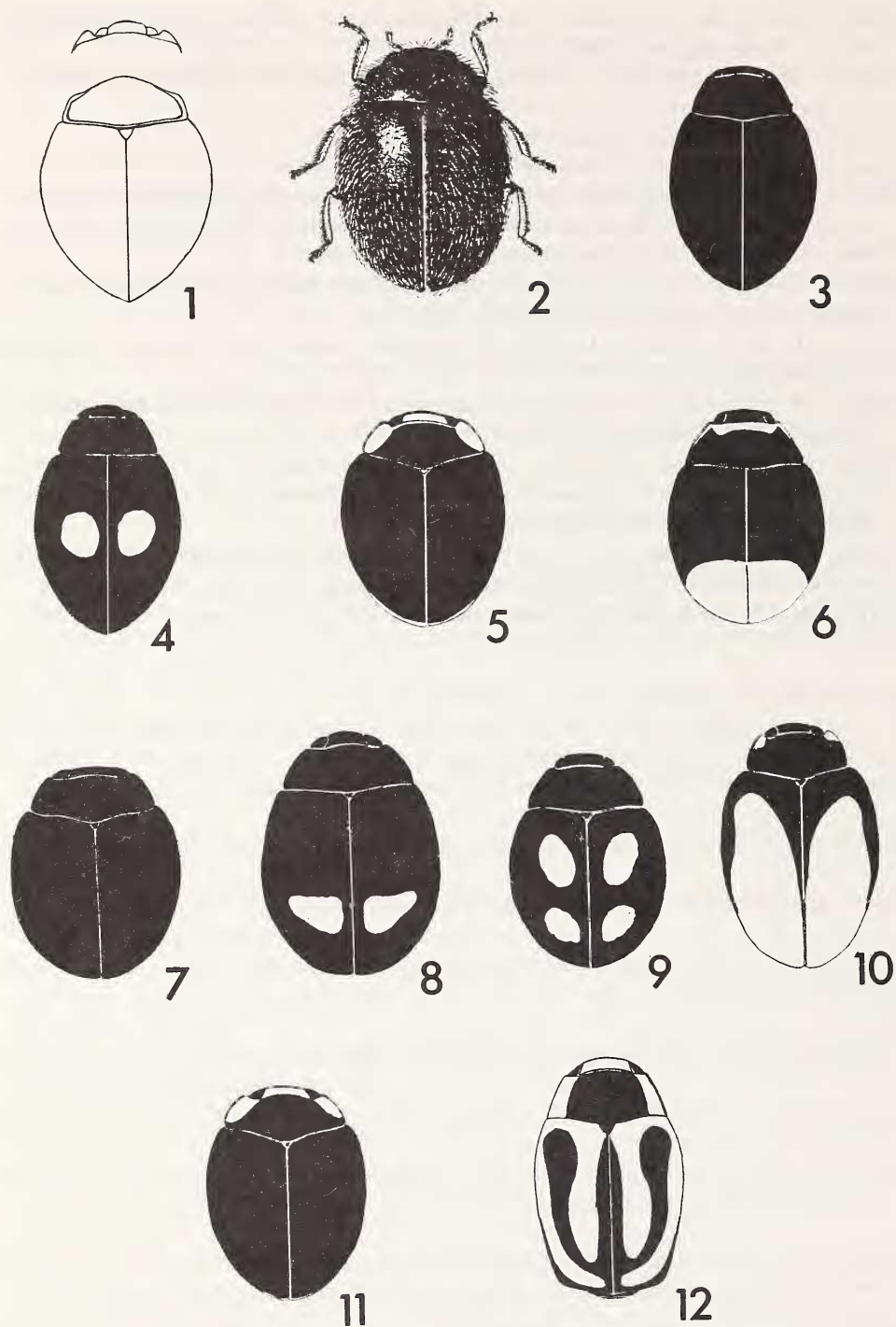


Fig. 1-12. Habitus and maculation. 1, *Microwiseia misella* (LeConte); 2, *Stethorus picipes* Casey; 3, *Didion longulum* Casey; 4, *D. punctatum* (Melsheimer); 5, *Scymnus (Scymnus) apicanus* Chapin; 6, *S. (Pullus) postpictus* Casey; 7, *S. (P.) lacustris* LeConte; 8, *Nephus georgei* (Weise); 9, *N. ornatus* LeConte; 10, *Scymnus (Pullus) coniferarum* Crotch; 11, *S. (P.) ardelio* Horn; 12, *Hyperaspidius vittigerus* (LeConte).

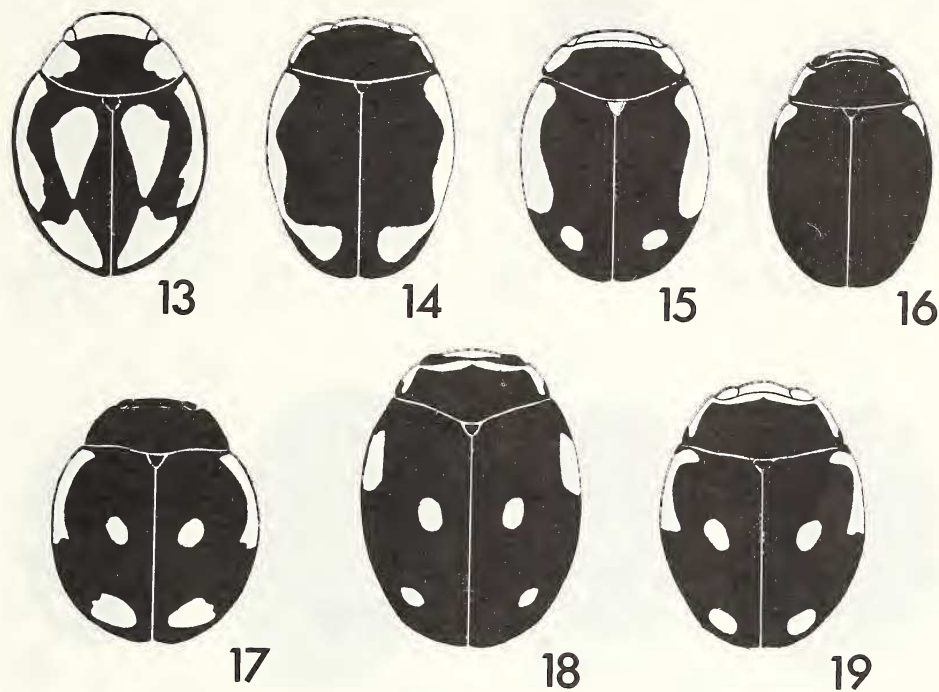


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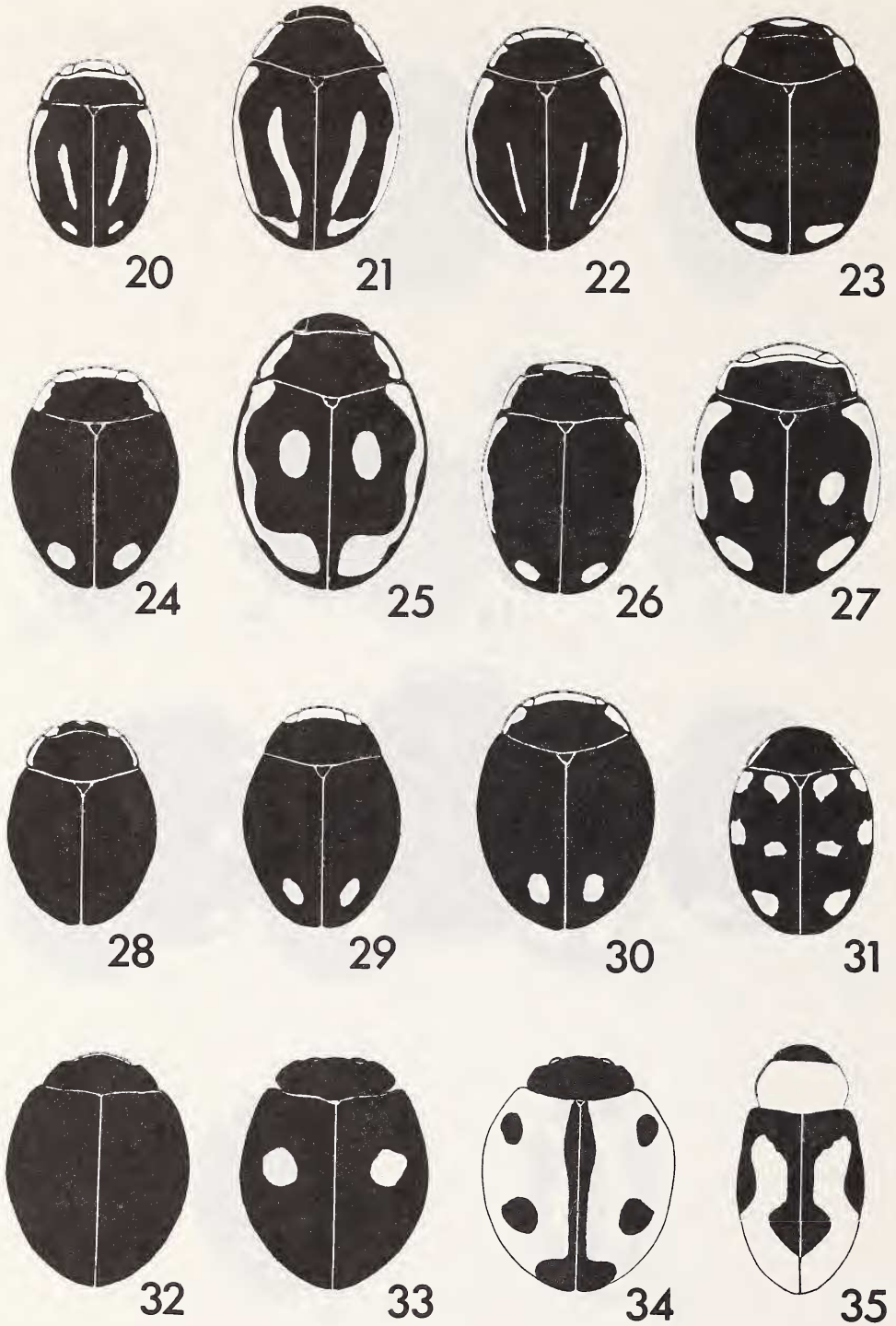


Fig. 20-35. Habitus and maculation. 20, *Hyperaspis oregona* Dobzhansky; 21, *H. annexa* LeConte; 22, *H. quadrivittata* LeConte; 23, *H. elliptica* Casey; 24, *H. postica* LeConte; 25, *H. undulata* (Say); 26, *H. lanei* Hatch; 27, *H. simulatrix* Dobzhansky; 28, *H. jasperensis*, new species; 29, *H. lugubris* (Randall); 30, *H. levraii* Mulsant; 31, *Brachiacantha ursina* (Fabricius); 32, *Exochomus aethiops* (Bland); 33, *Chilocorus stigma* (Say); 34, *Brumoides septentrionis* (Weise); 35, *Coccidula occidentalis* Horn.

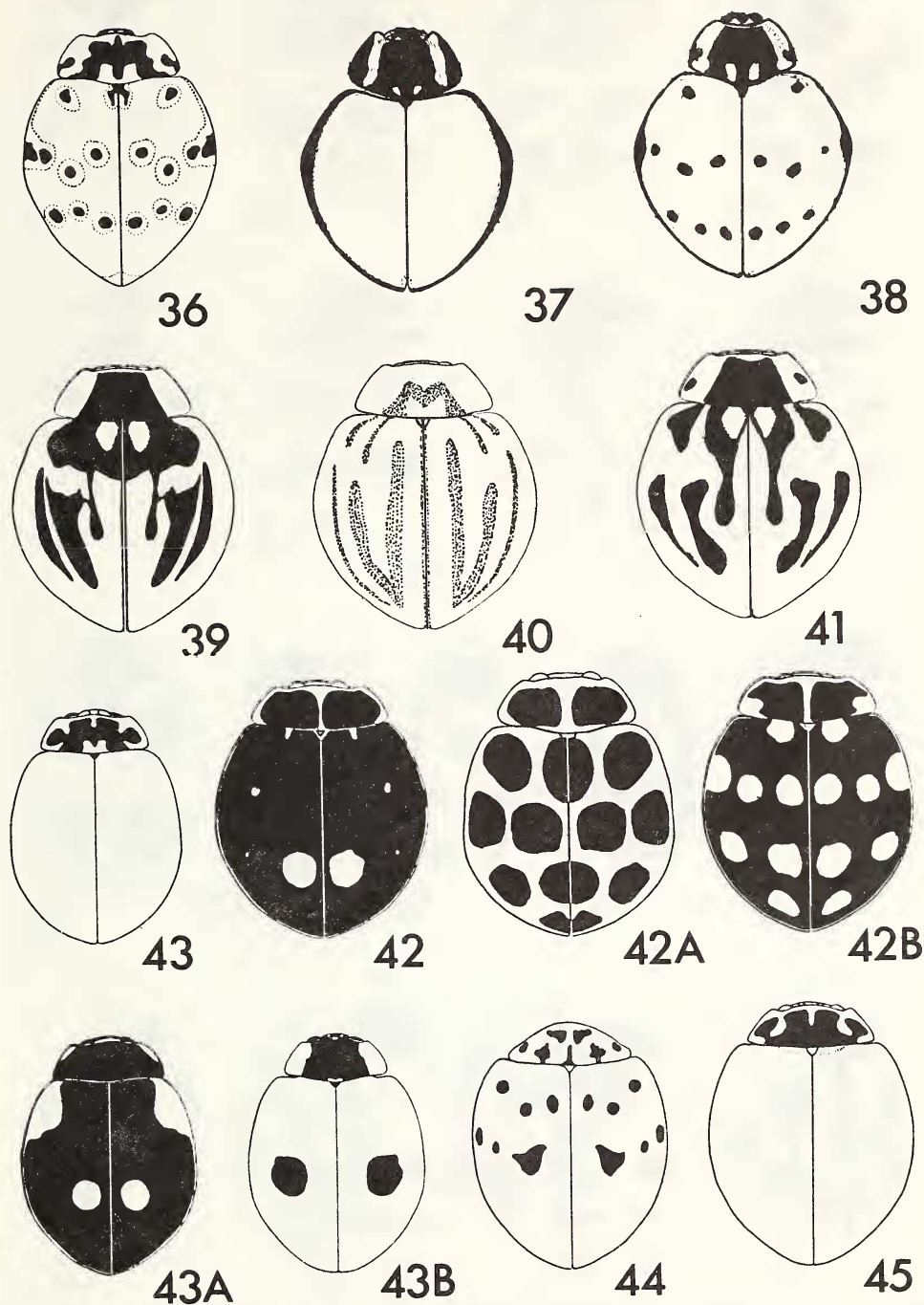


Fig. 36-45. Habitus and maculation. 36, *Anatis borealis*, new species; 37, *A. lecontei* Casey; 38, *A. rathvoni* (LeConte); 39, *Myzia subvittata* (Mulsant); 40, *M. horni* Crotch; 41, *M. pullata* (Say); 42, 42A, 42B, *Calvia quatuordecimguttata* (Linnaeus); 43A, 43B, *Adalia bipunctata* (Linnaeus); 44, *Olla v-nigrum* (Mulsant); 45, *Cycloneda polita* Casey.

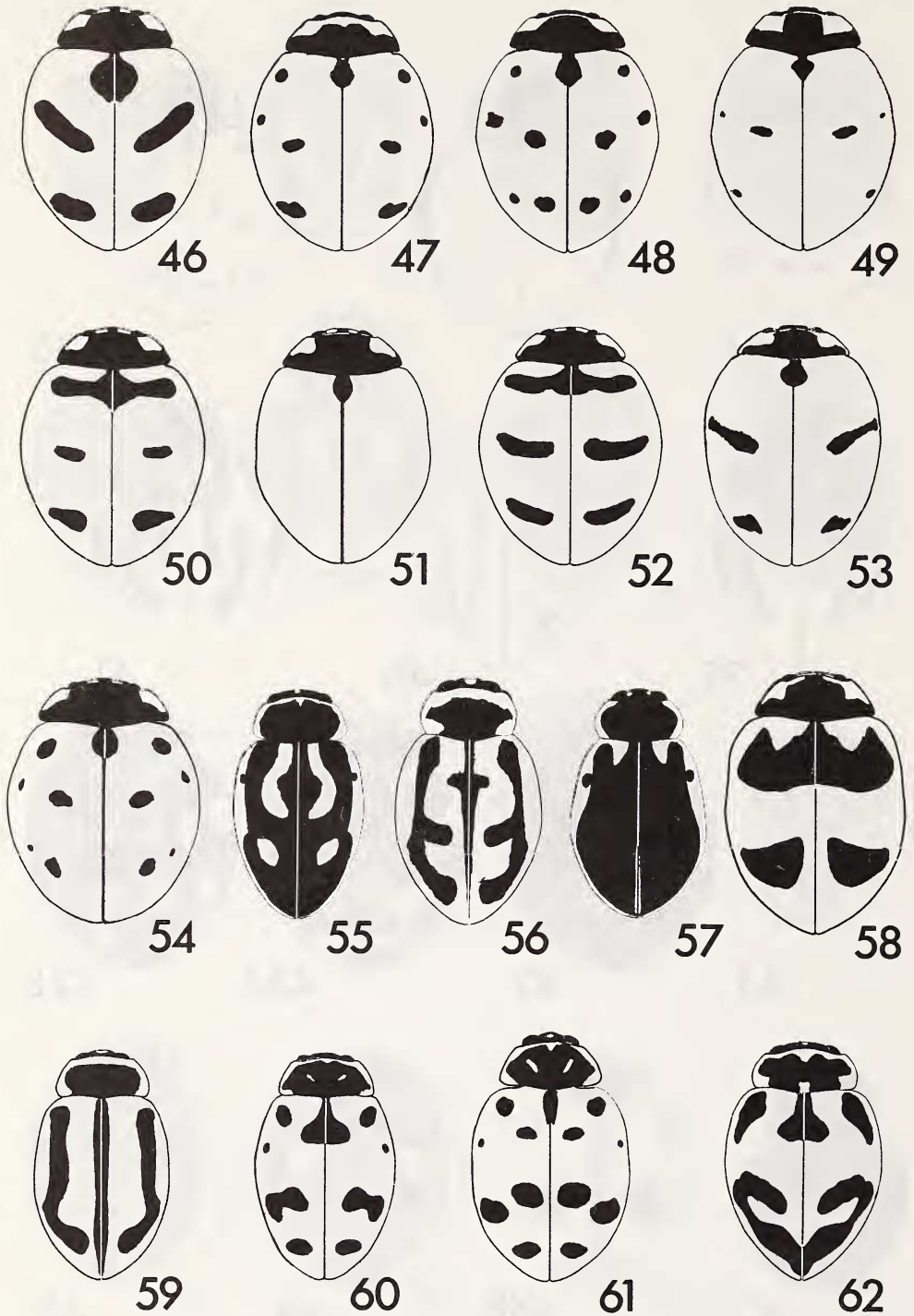


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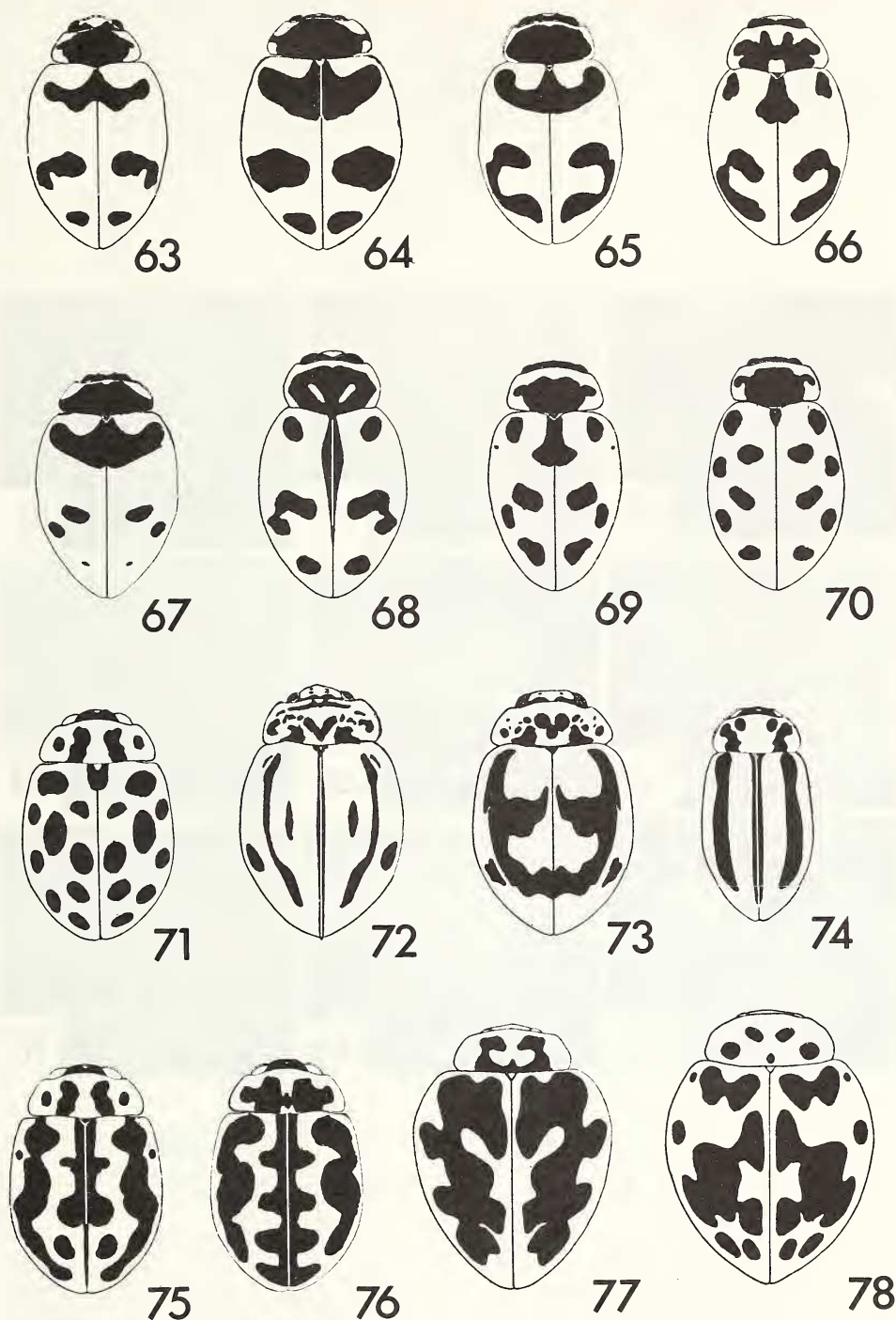


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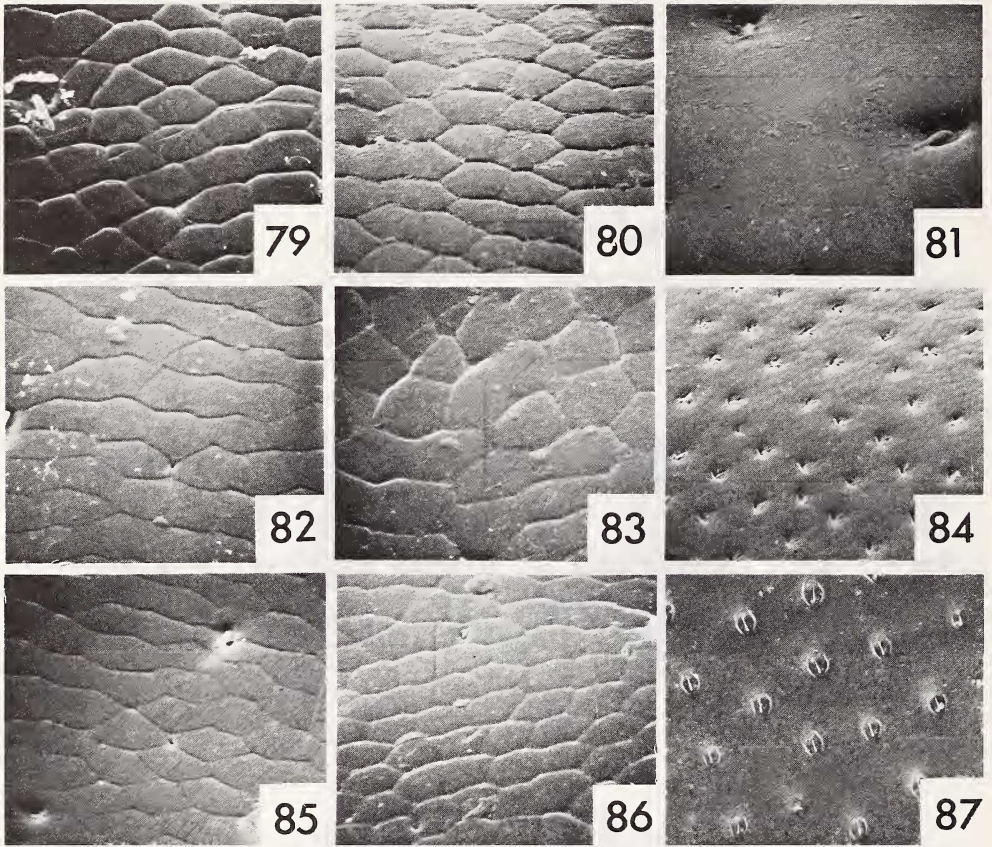


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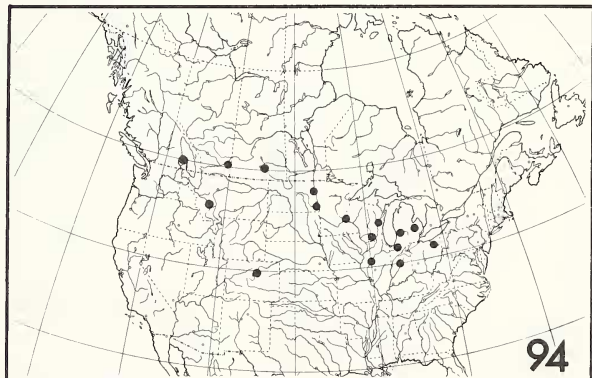
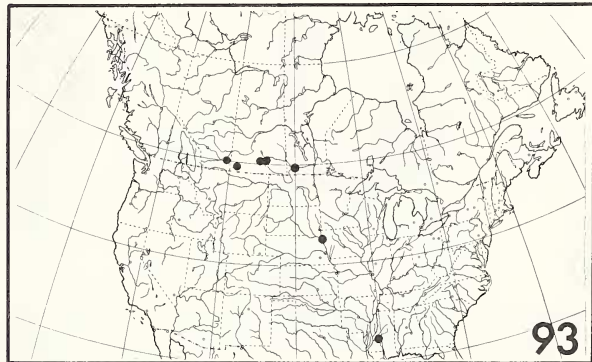
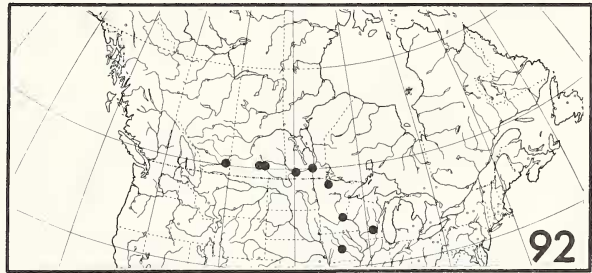
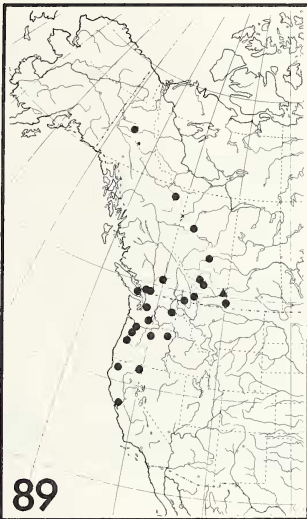
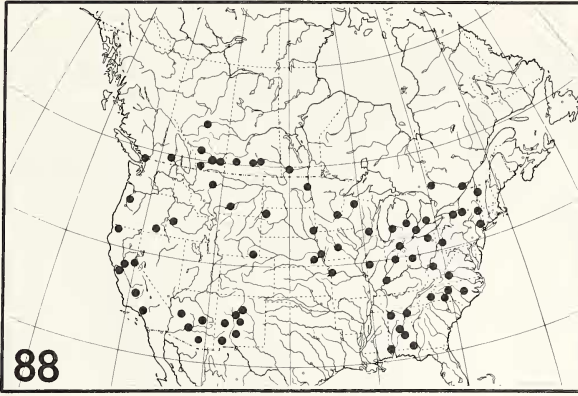


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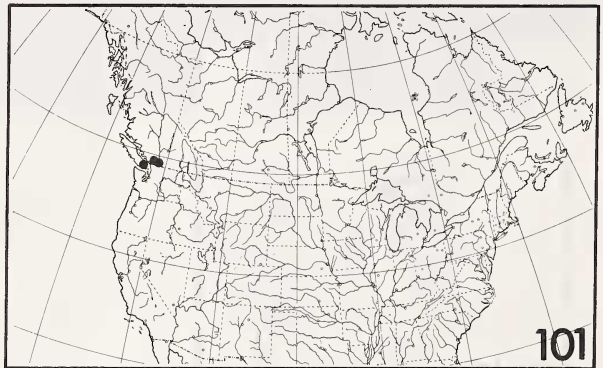
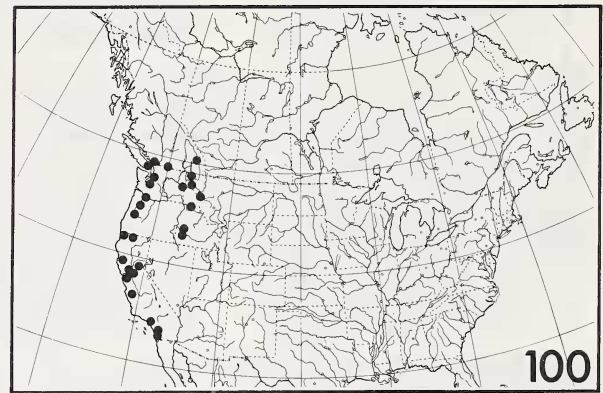
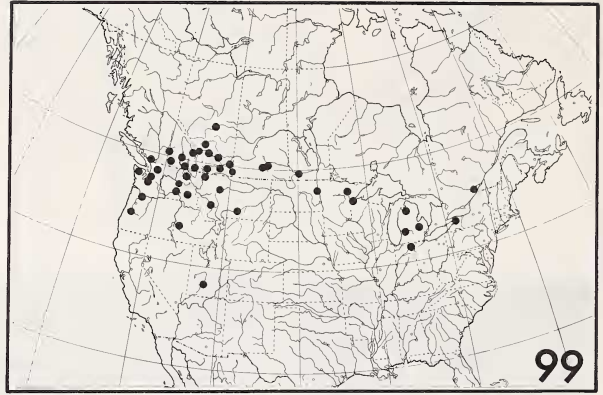


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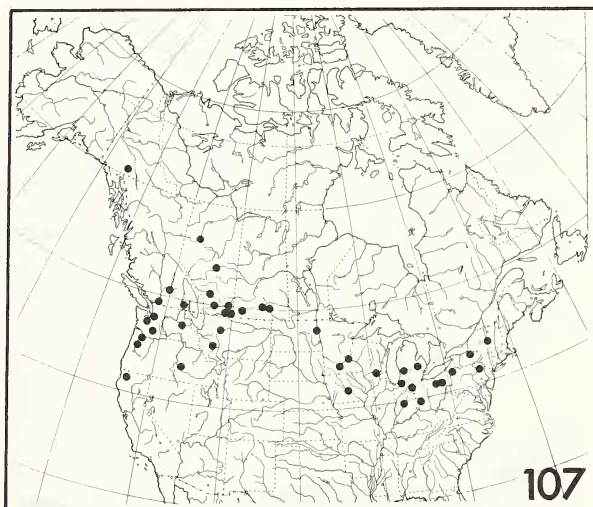
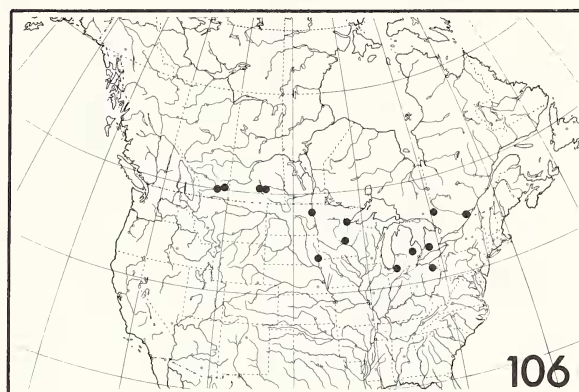
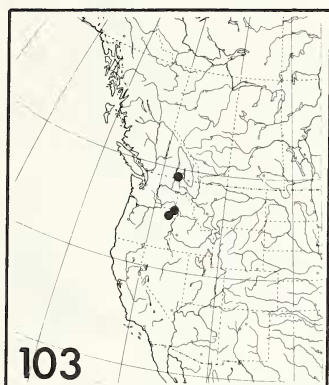
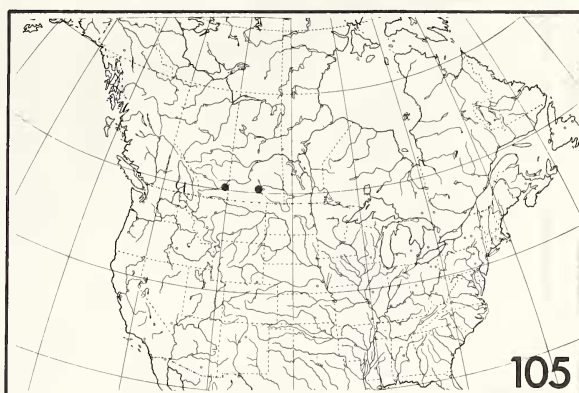
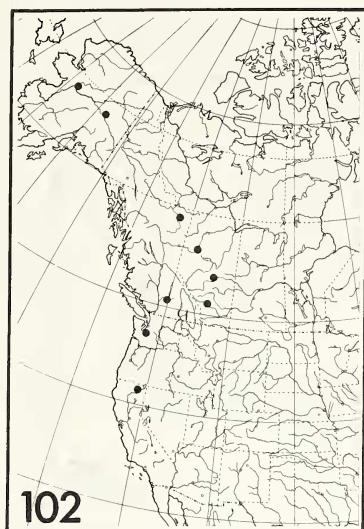
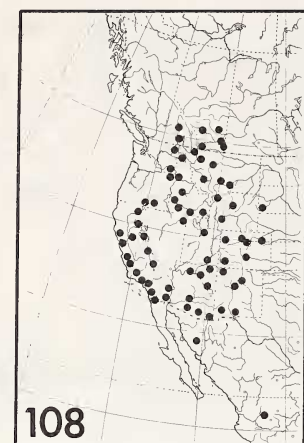
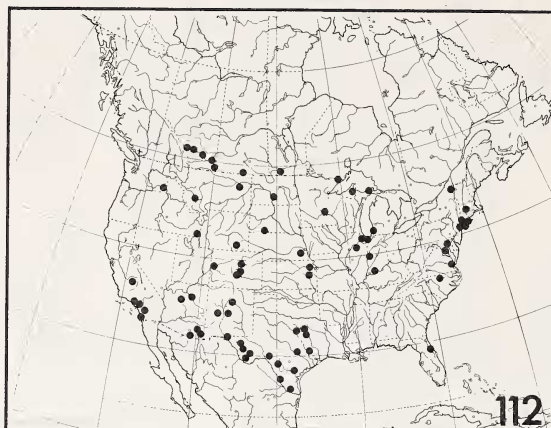


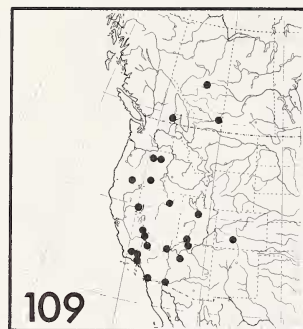
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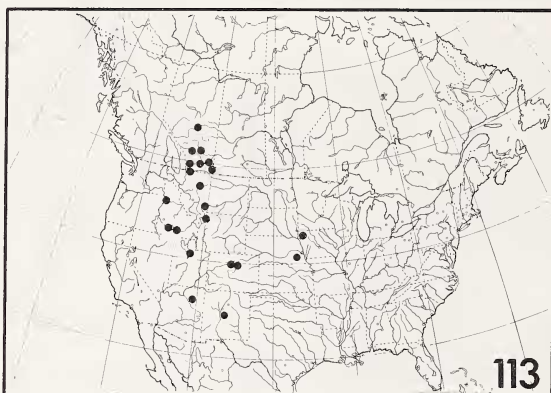
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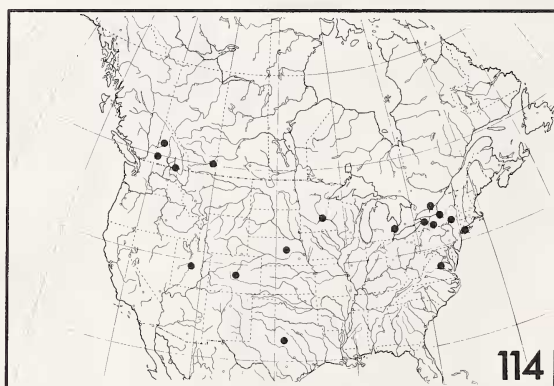
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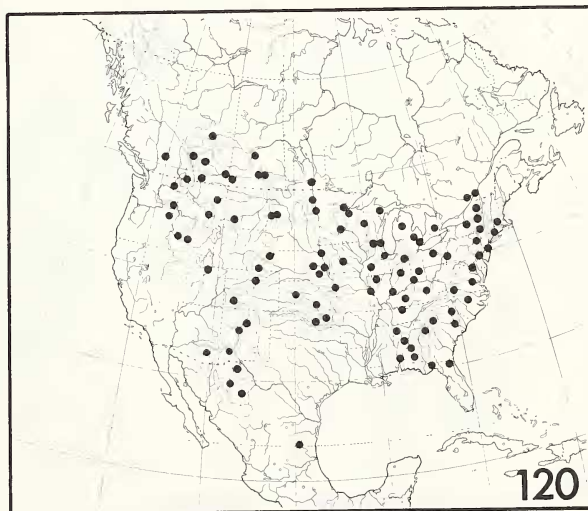
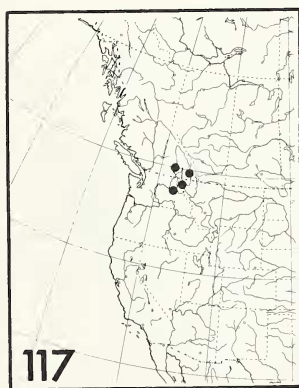
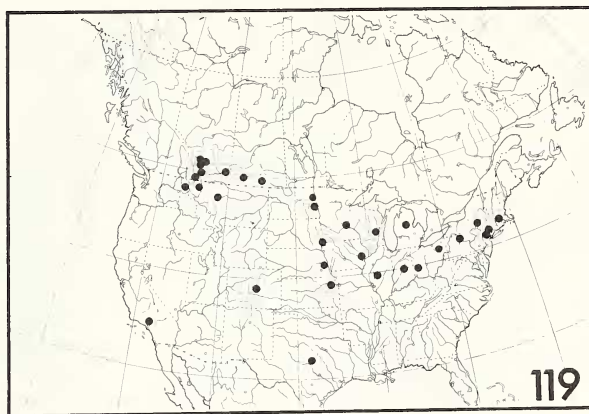
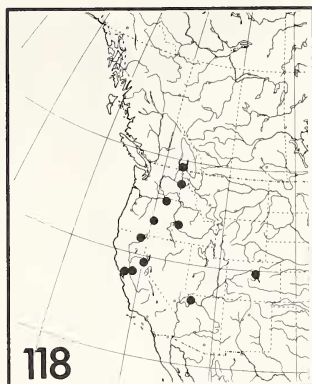


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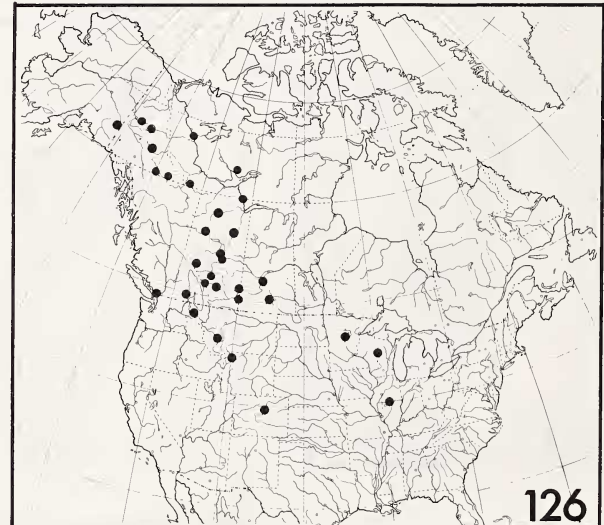
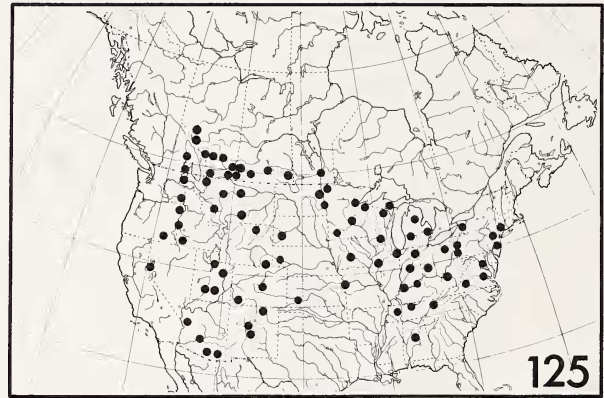


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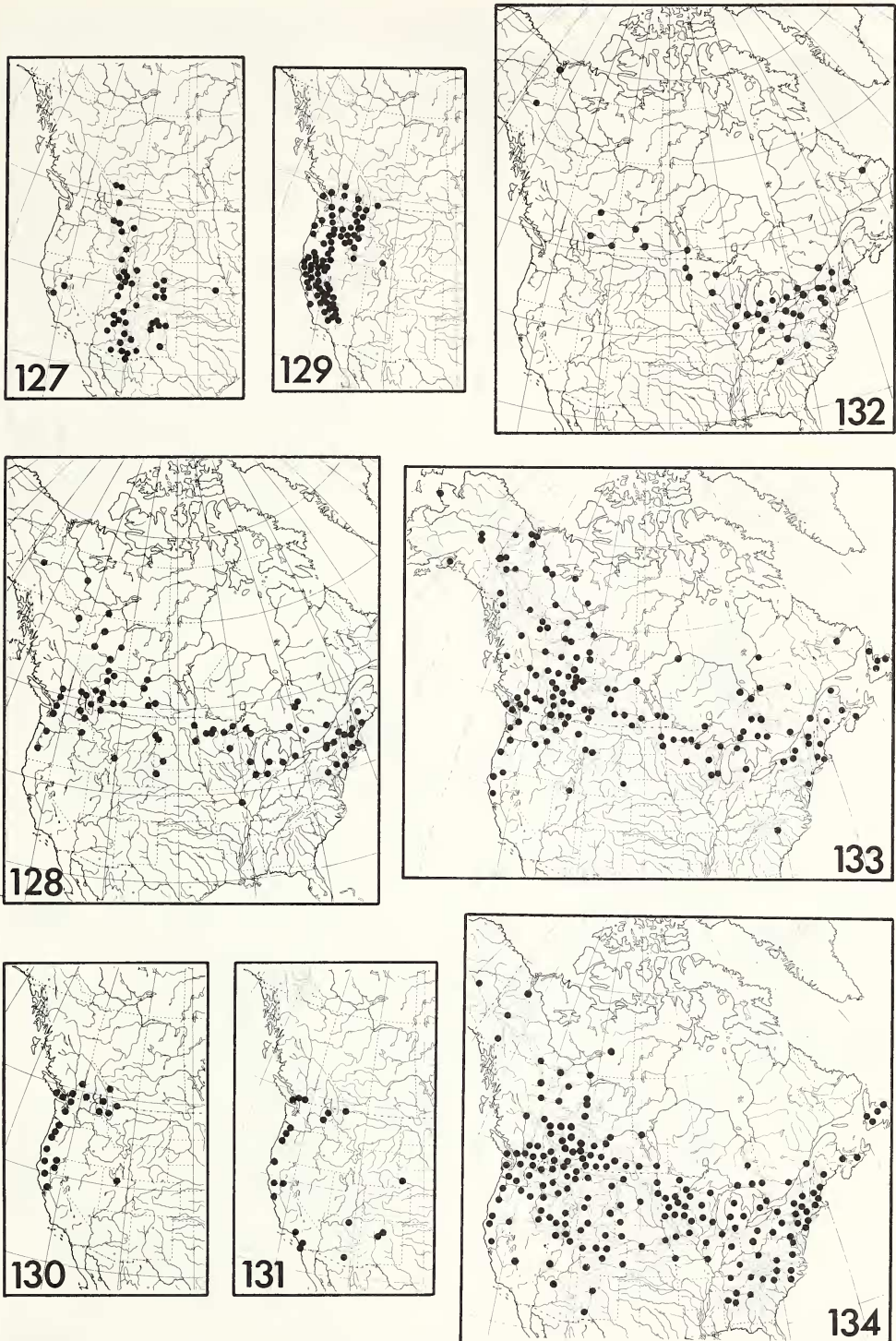


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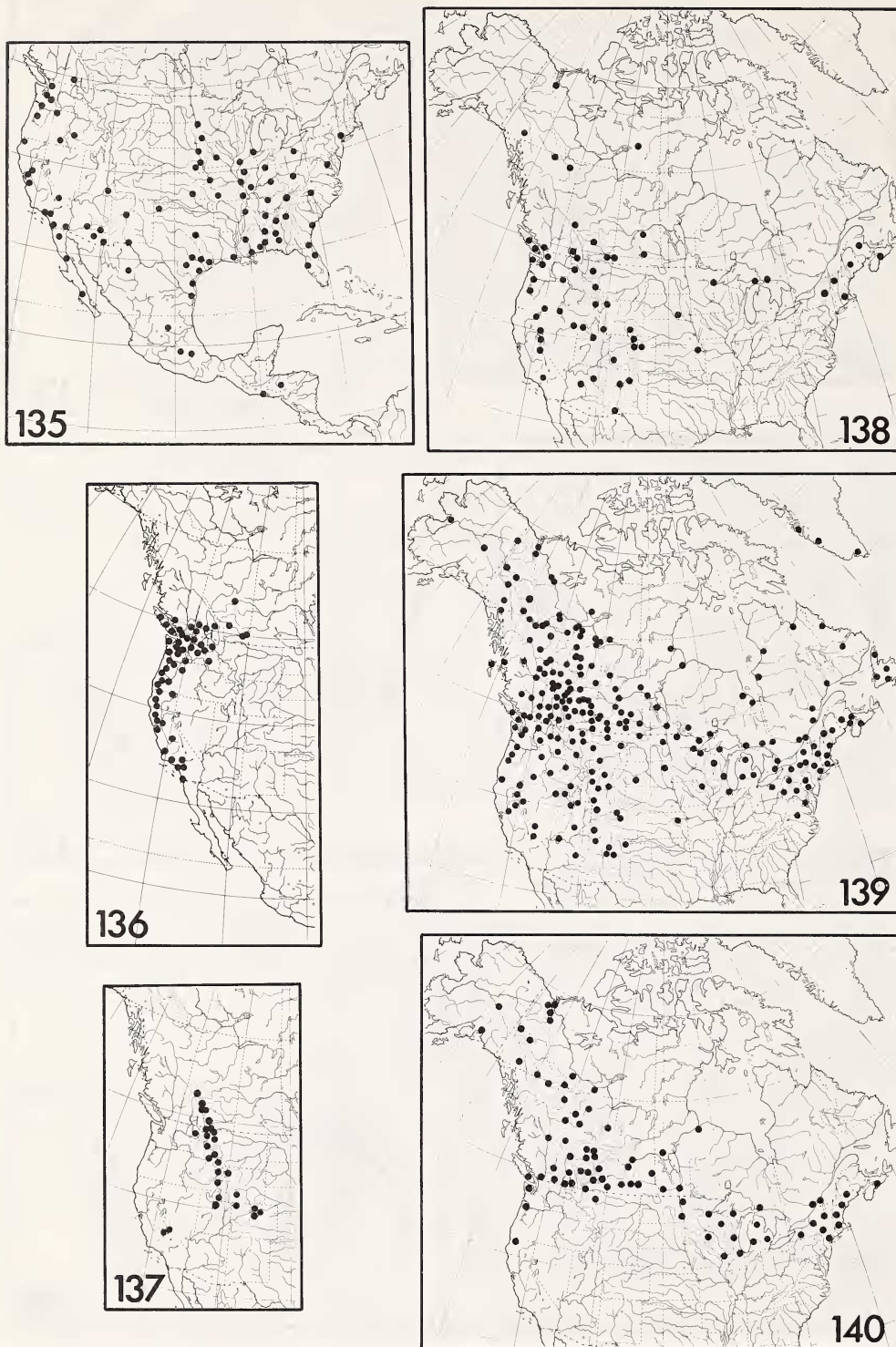


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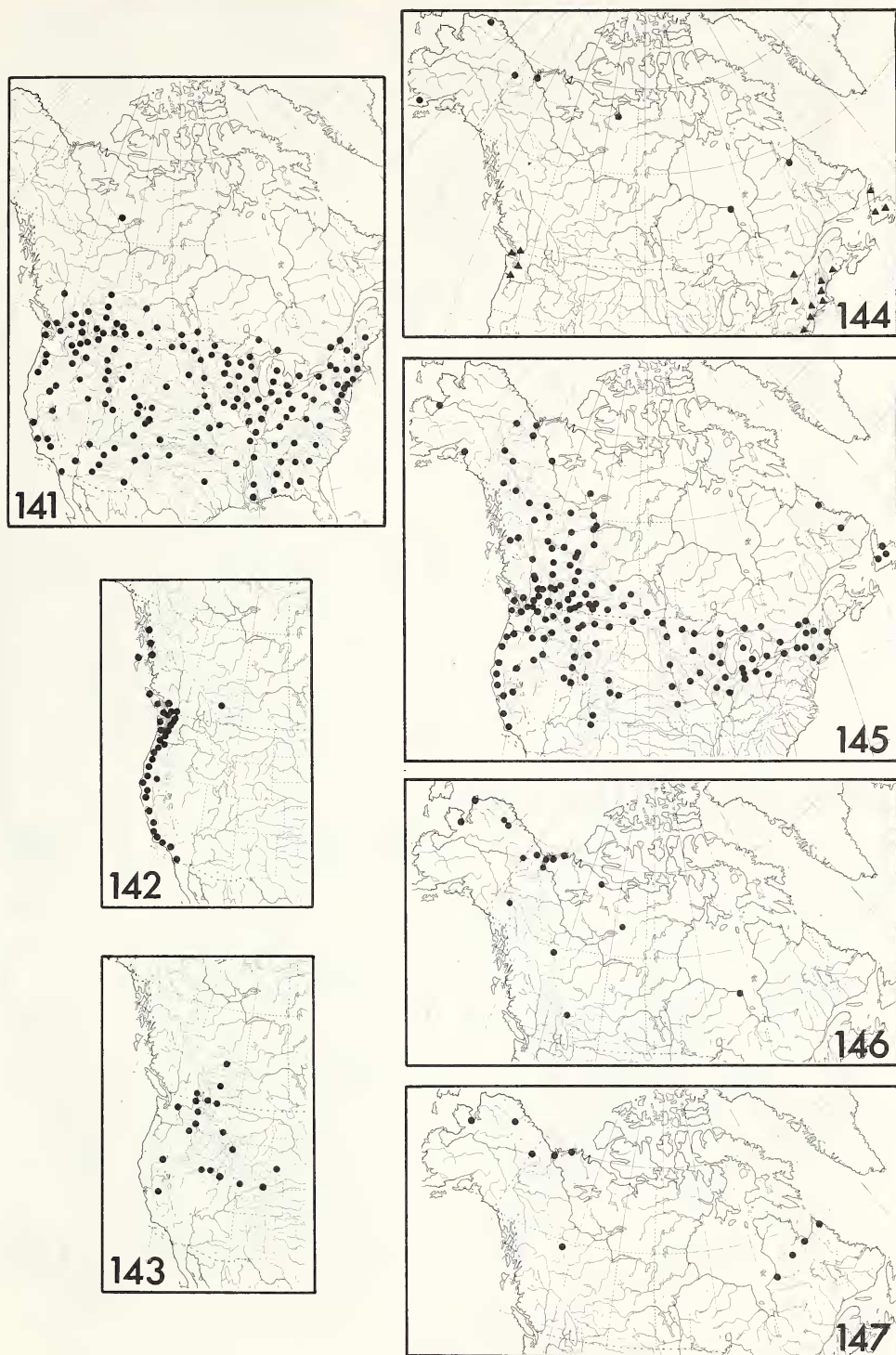


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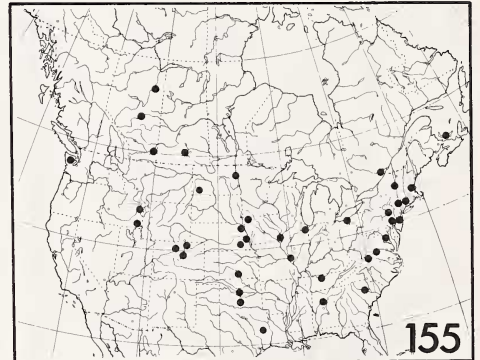
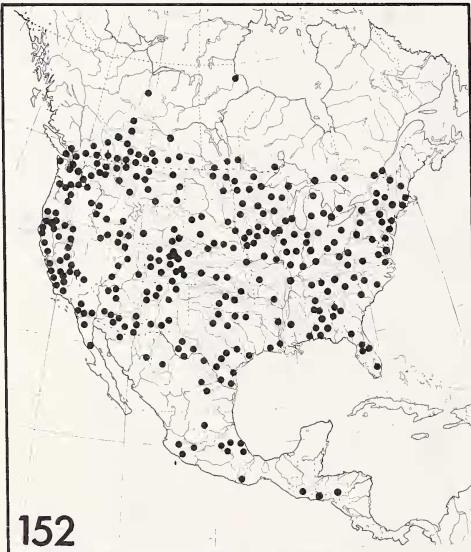
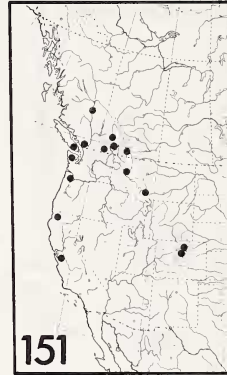
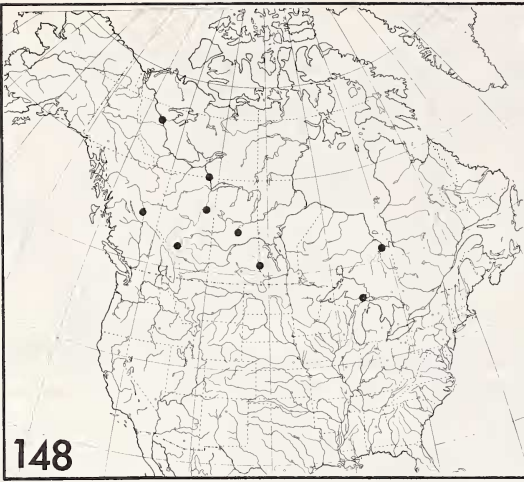


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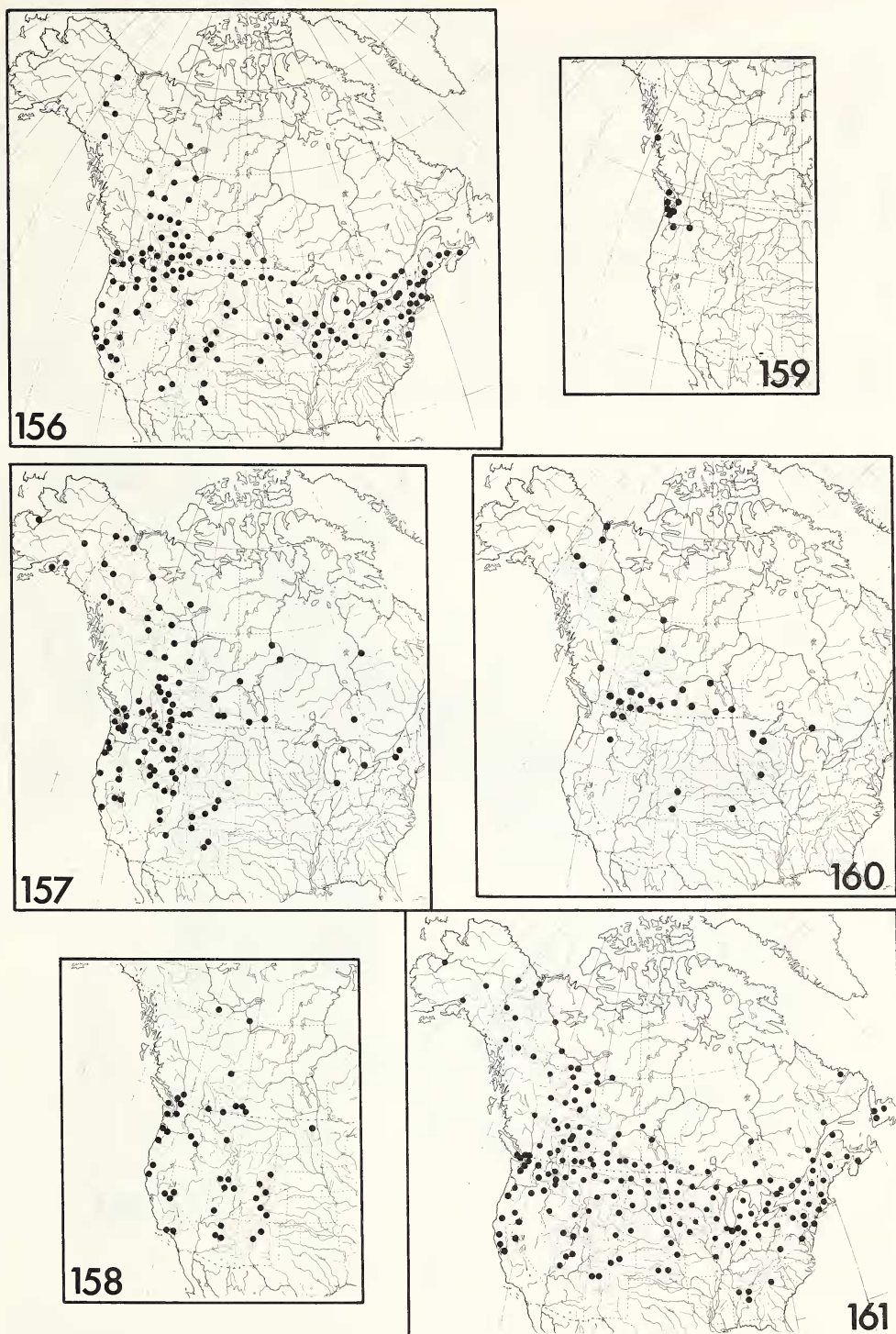


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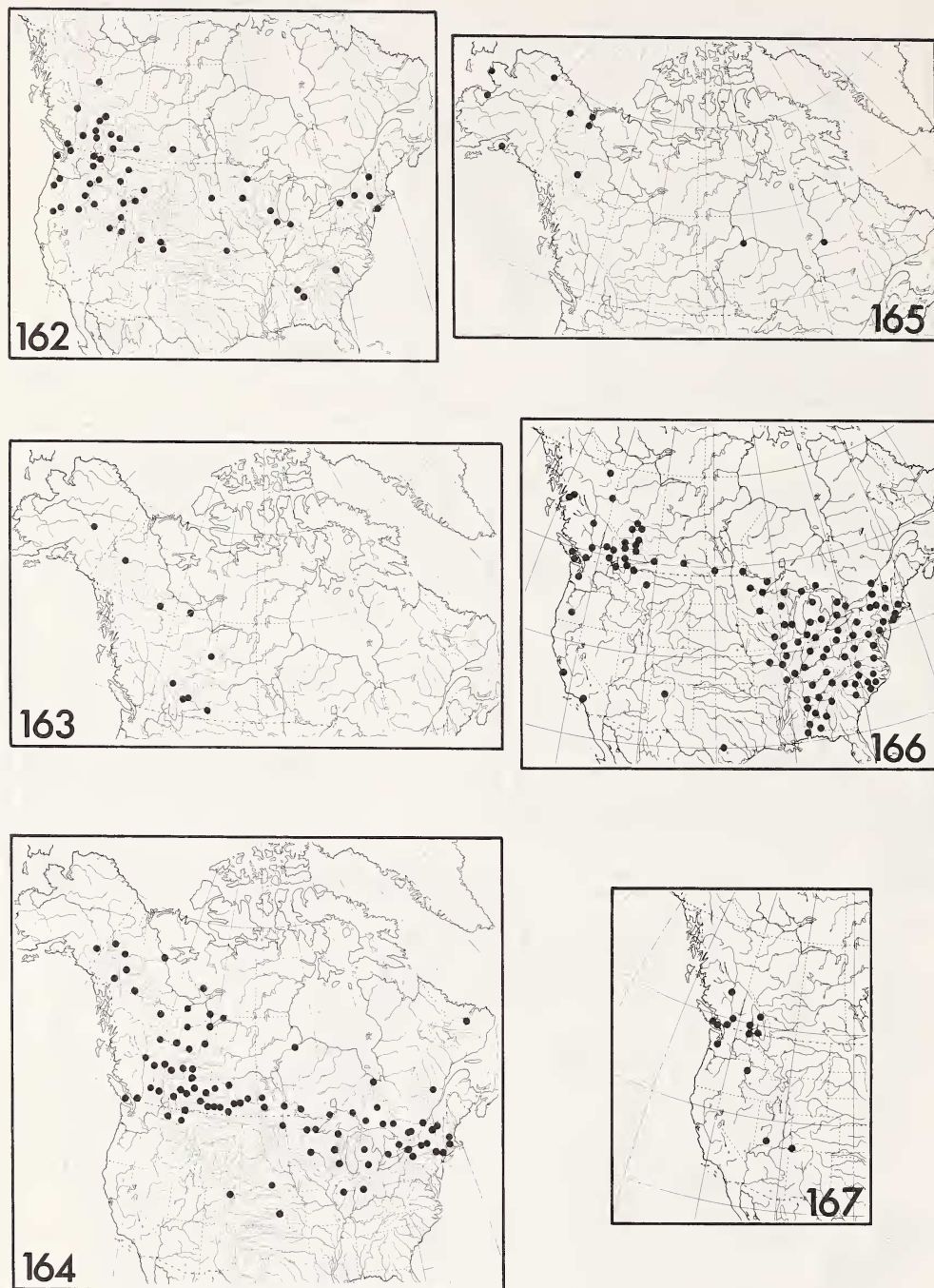
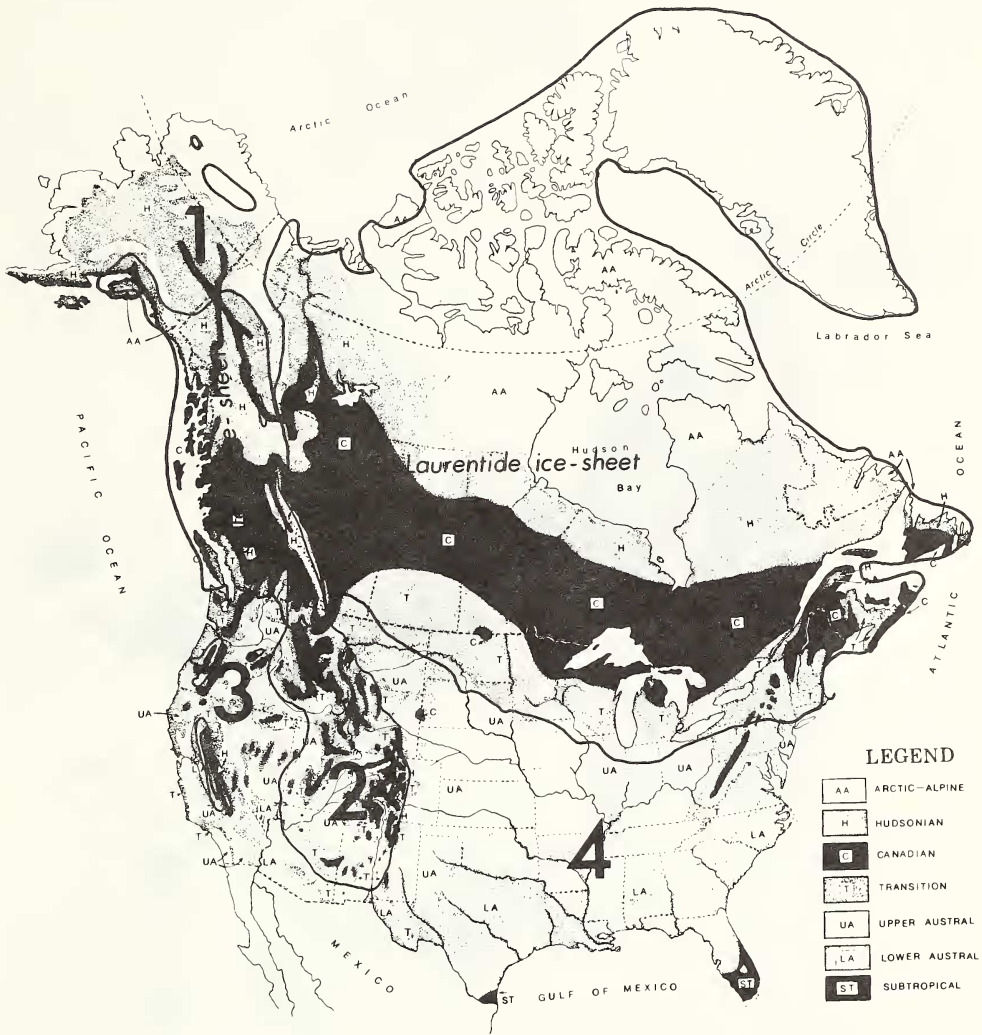


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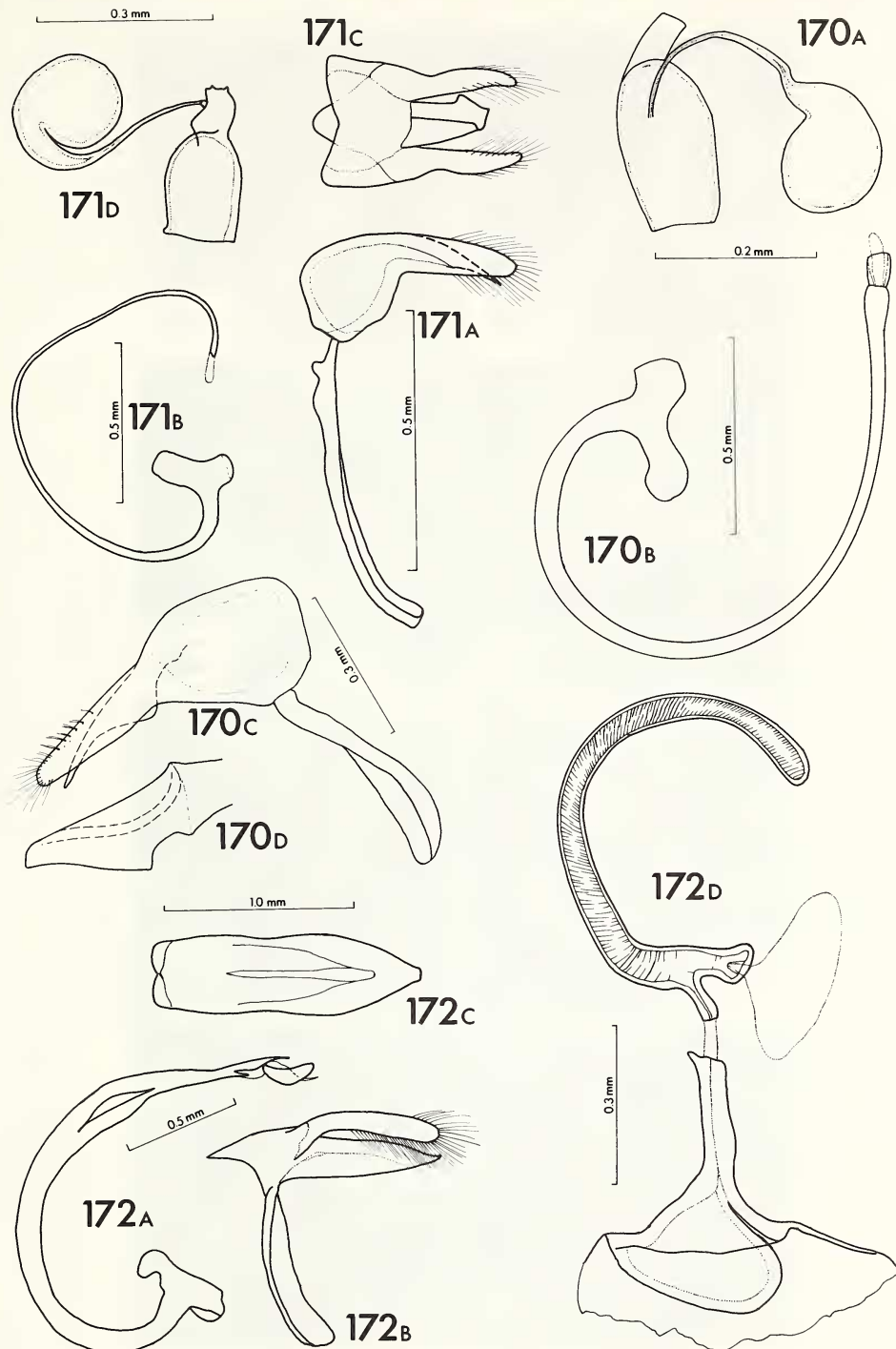


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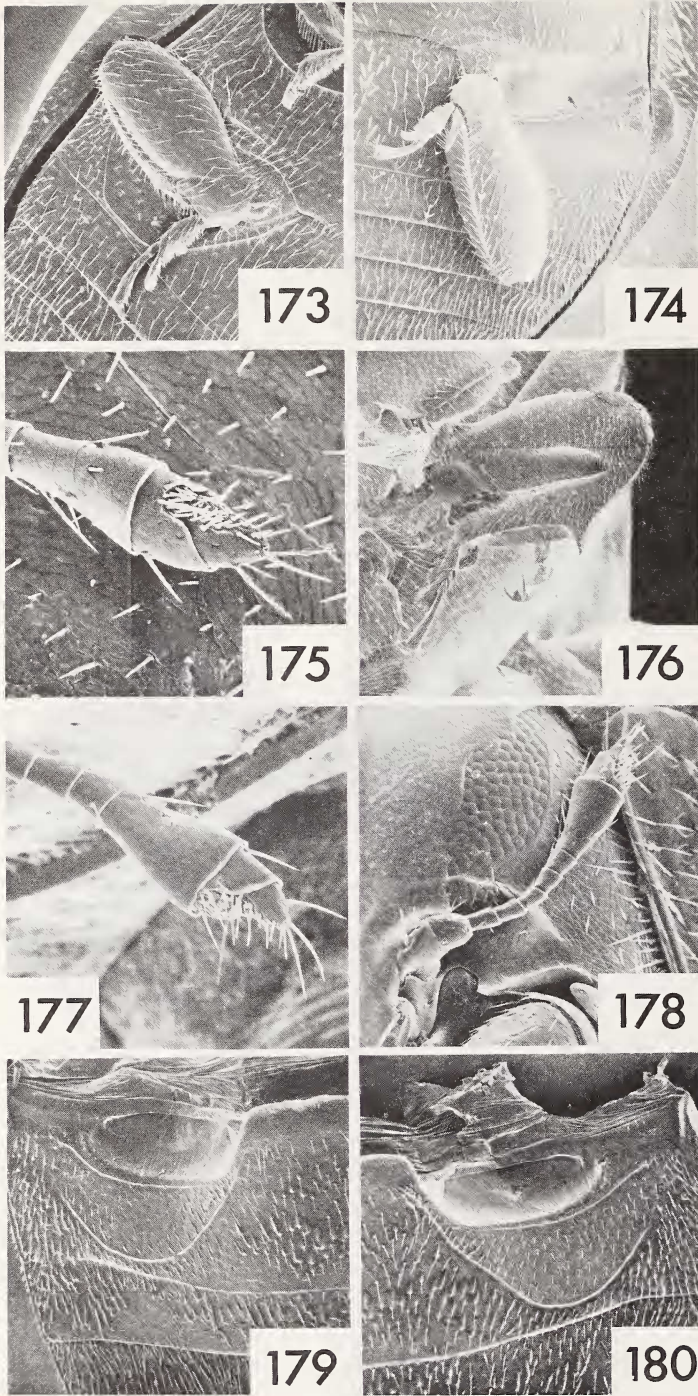


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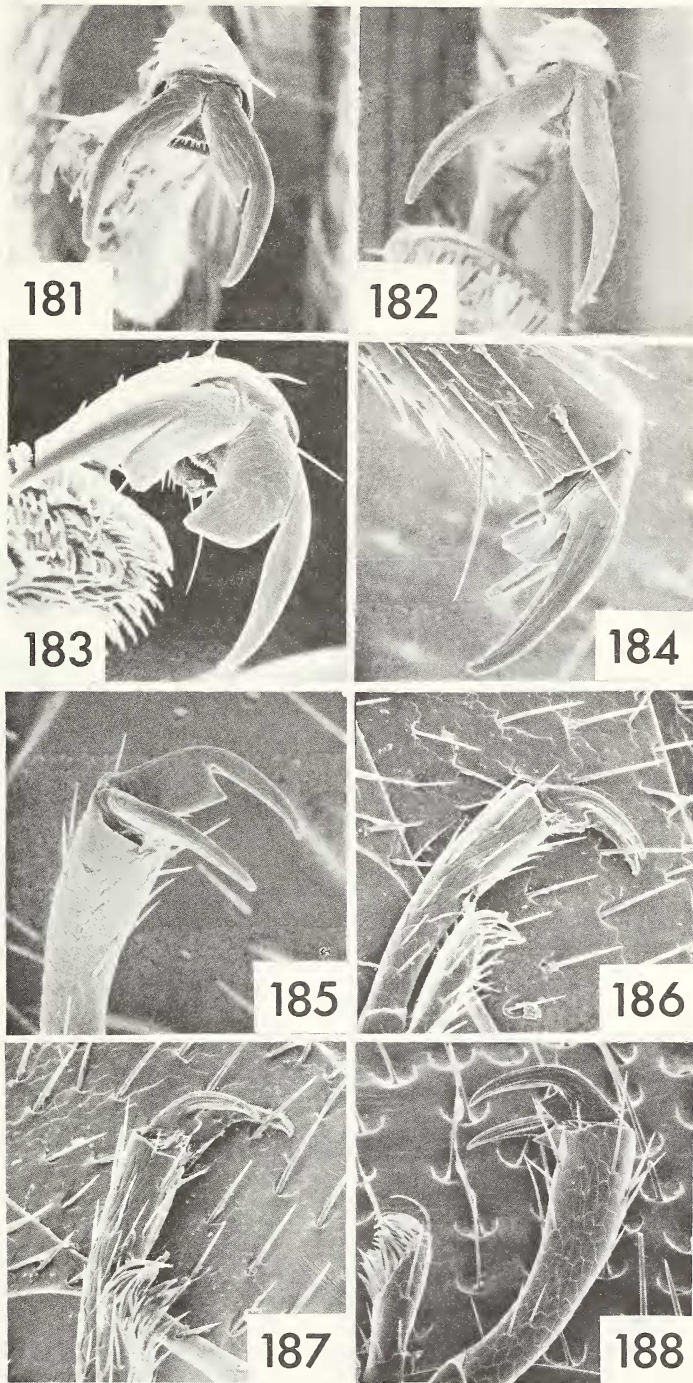
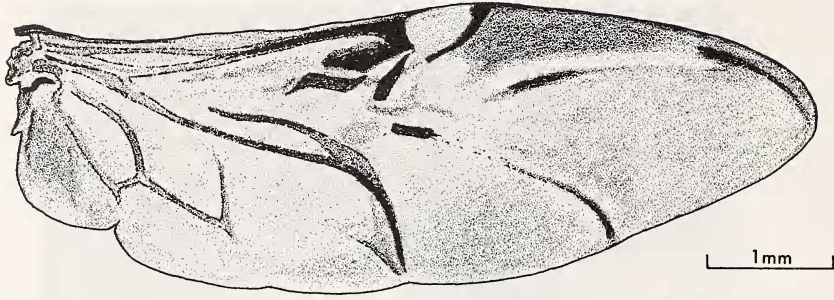
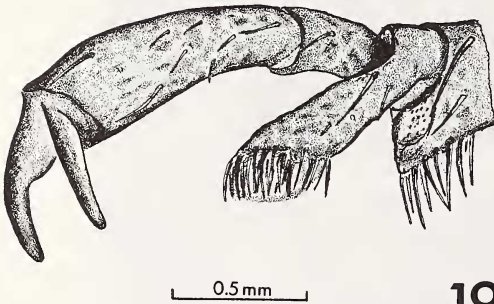


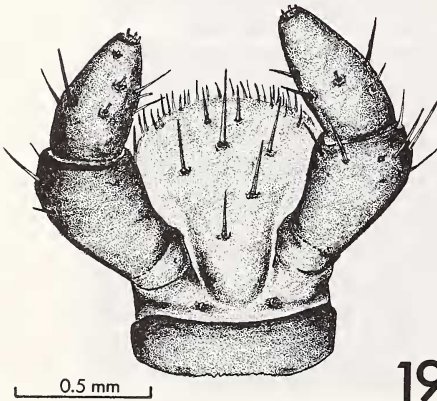
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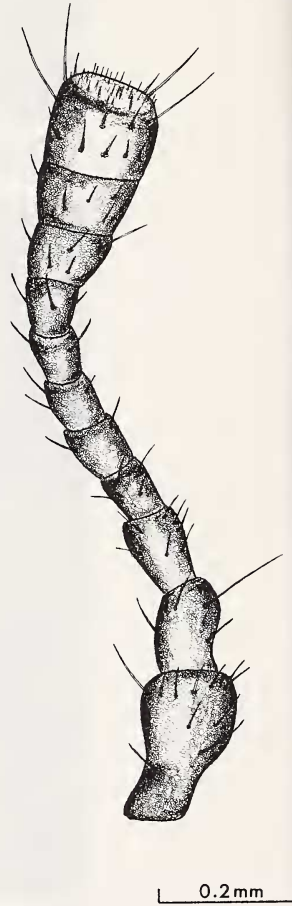
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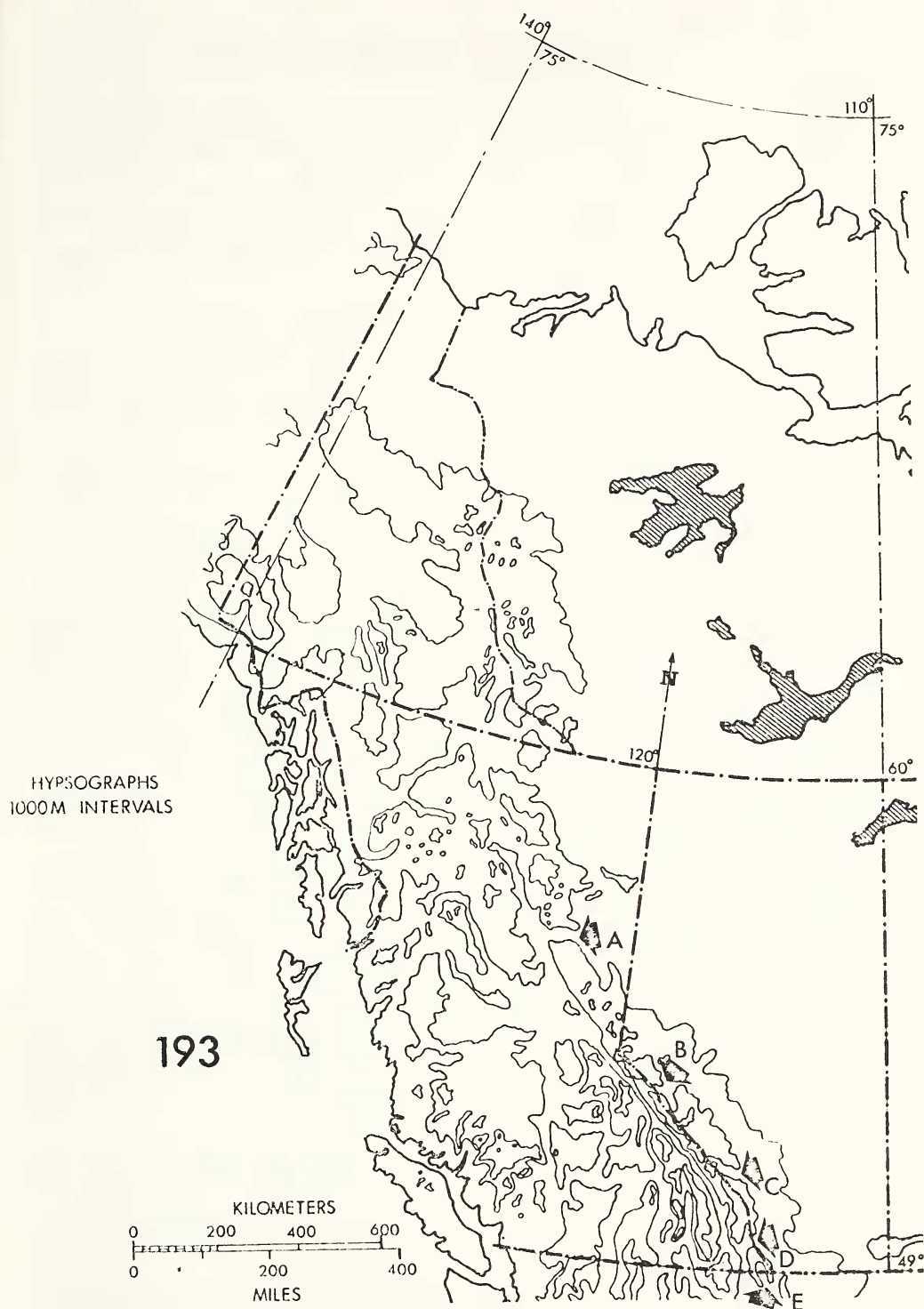


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